

STEM

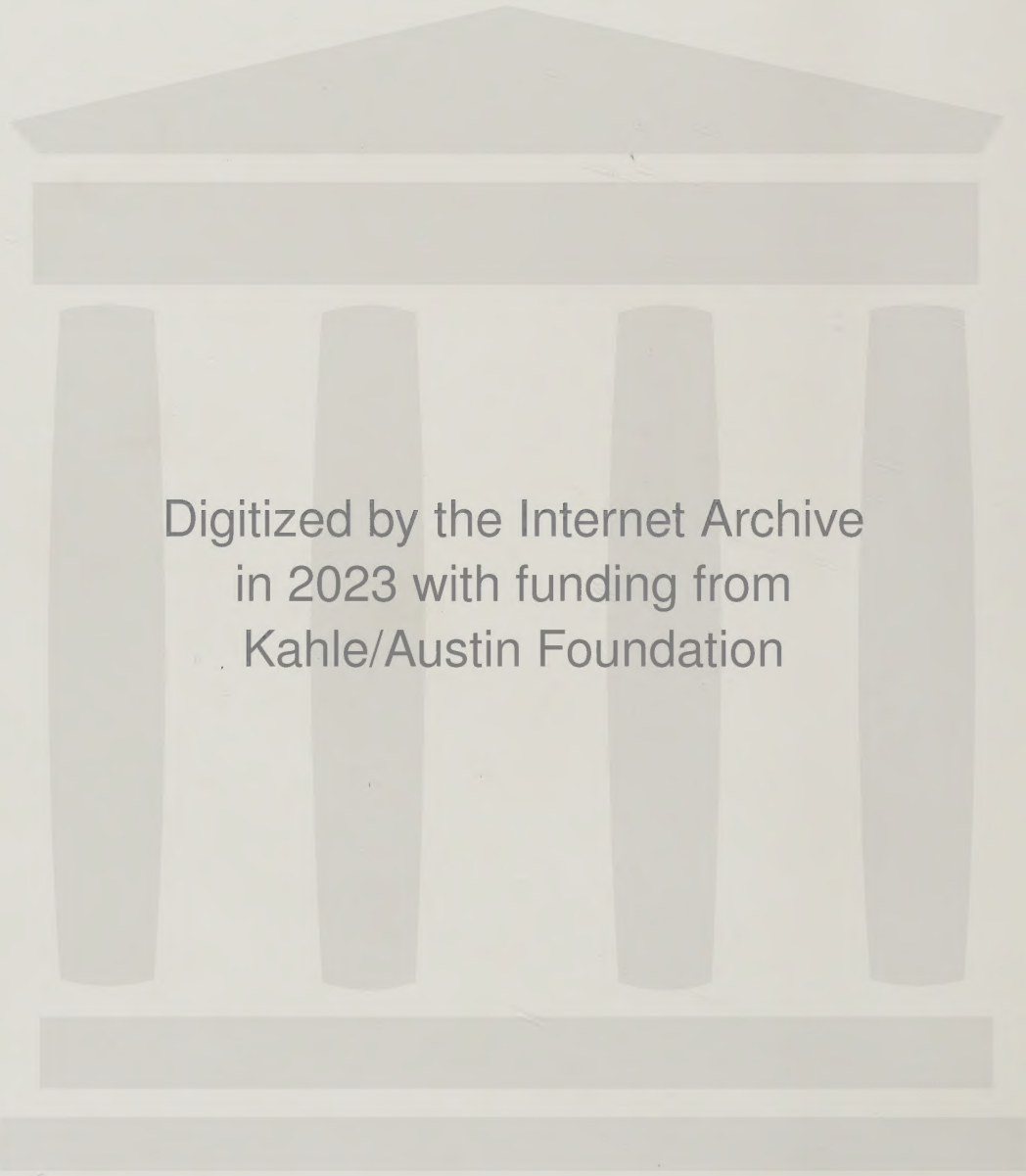
ACTIVITY BOOK

SCIENCE TECHNOLOGY
ENGINEERING MATHS

Packed with activities
and facts

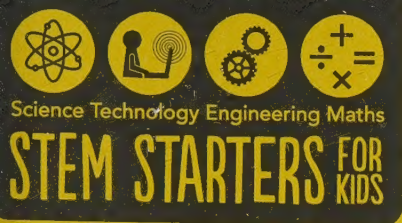


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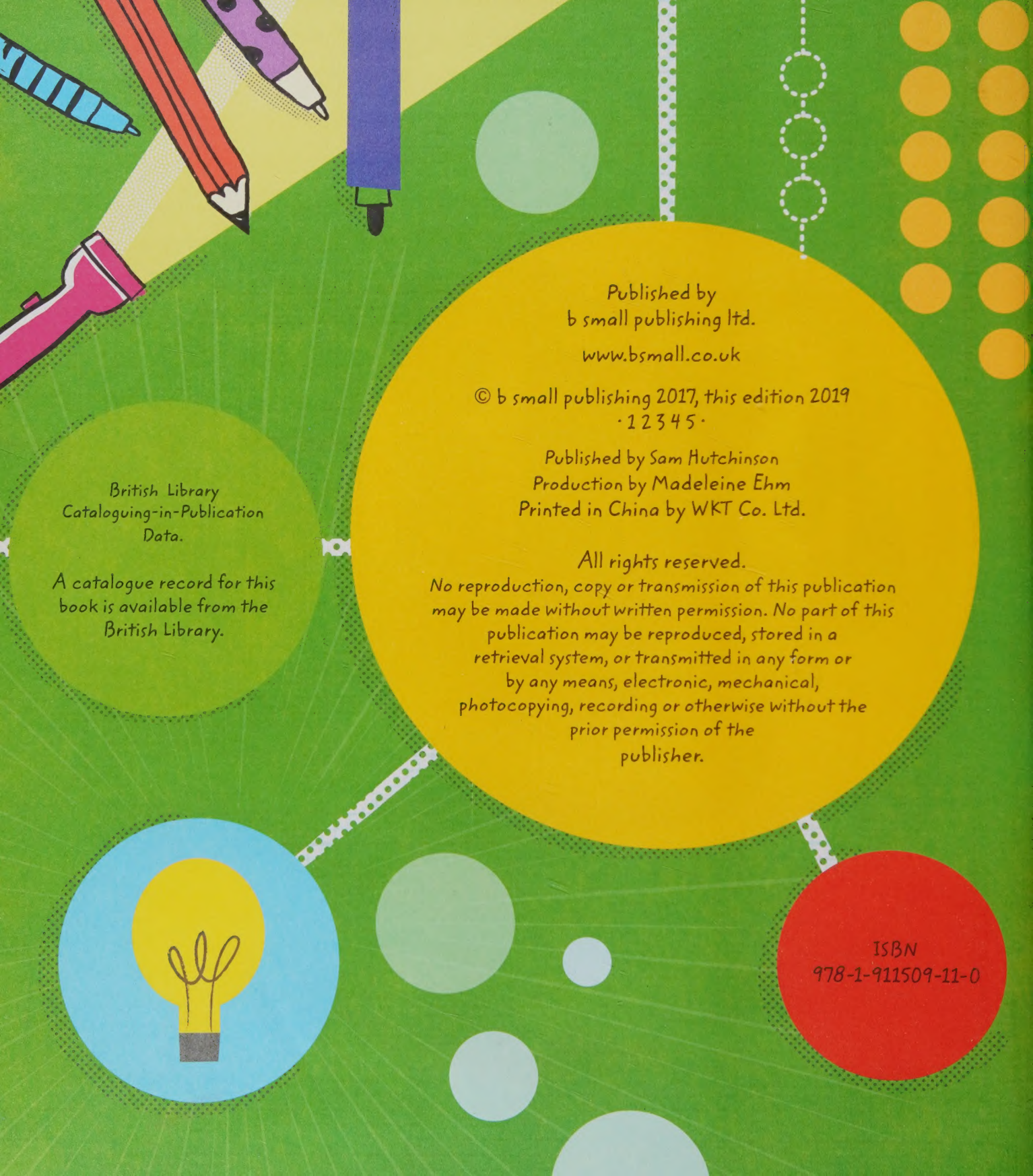
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STEM

ACTIVITY BOOK

SCIENCE TECHNOLOGY
ENGINEERING MATHS



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Science Technology Engineering Maths

STEM STARTERS FOR KIDS



STEM

ACTIVITY BOOK

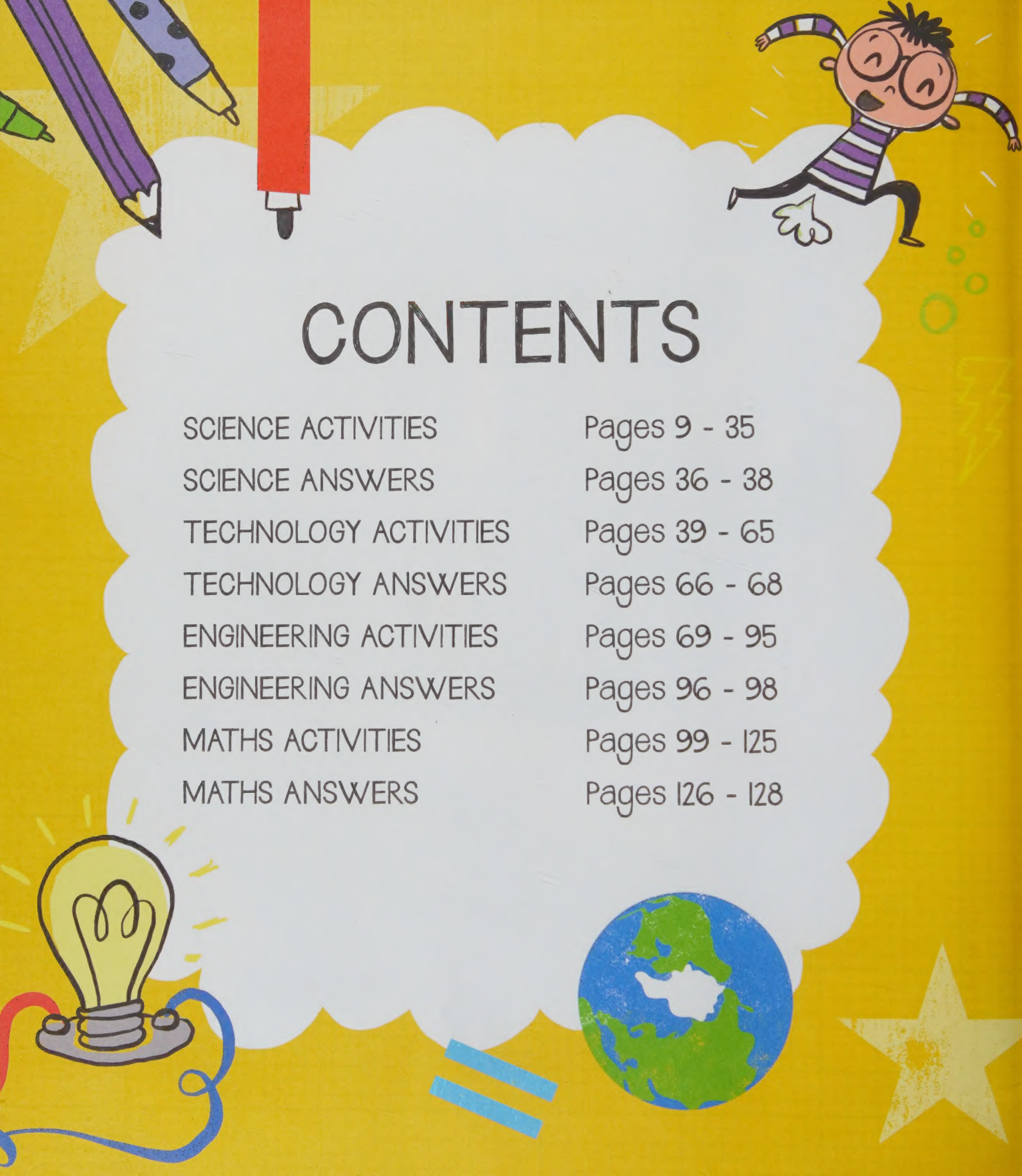
SCIENCE TECHNOLOGY
ENGINEERING MATHS

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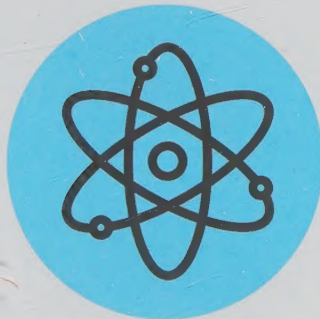
MATHS ANSWERS

Pages 126 - 128

WHAT IS STEM?

STEM stands for 'science, technology, engineering and mathematics'. These four areas are closely linked, and engineers couldn't do their jobs without science, technology or maths. Maths and science are the tools that engineers use to solve problems and create machines.

Engineers pay attention to new discoveries in science as inspiration for new tools they can use to solve problems in ways that hadn't been possible before.



Science



Technology



Engineering



Maths





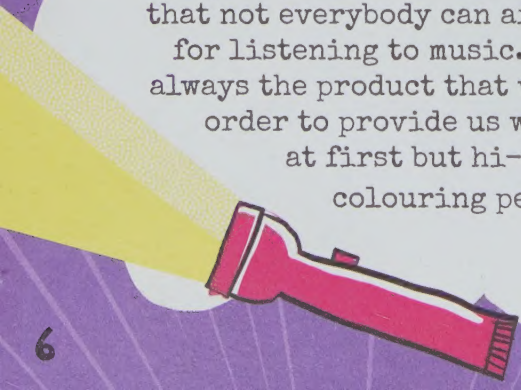
WHAT IS SCIENCE?

Science is more than bubbling liquids and test tubes. Science is about trying to understand the world around us, learning from it and using that information in the future. This information comes from experiments that have to follow strict rules so that the results can be trusted. Without strong evidence, someone's idea is just an idea and not a scientific fact.

WHAT IS TECHNOLOGY?

Technology is the practical application of scientific knowledge by engineers and scientists. Their aim is to improve the things around us. Touchscreen mobile phones are a good example of how technology can make our lives easier. Or the simple and humble door hinge!

Not all technology is shiny and digital. The best inventions are those that everybody can benefit from. There is a lot of technology that is very impressive but that not everybody can afford to use like fancy cars or sophisticated sound systems for listening to music. One other thing to think about is that technology is not always the product that we are using. A lot of industries rely on new technology in order to provide us with new and exciting products. It might not be obvious at first but hi-tech machines are necessary to create things like colouring pencils, chargers or even our favourites sweets.





WHAT IS ENGINEERING?

Engineering is about finding a problem to solve and finding a way to solve it. Engineers have to pay attention to all sorts of things going on in the world to notice problems they could help with. Then they need to be very creative to find ways of solving those problems. Engineers make things by designing, building and using machines. These machines can be anything from a simple toothbrush (solving the problem of cleaning teeth) to something huge like a wind turbine (solving the problem of finding clean energy).



WHAT IS MATHS?

Maths is more than just adding up, taking away, multiplying and dividing. Maths is more than just numbers! Maths is part of everybody's daily life, from spending money and checking your change, to following a recipe correctly - even finding patterns in the world and sharing properly with your friends.





Science Technology Engineering Maths

STEM STARTERS FOR KIDS

SCIENCE ACTIVITY Book



OBSERVING ODDITIES

Top scientists use big words to describe their observations properly. They will use words like **OPAQUE** (you cannot see through it) or **TRANSPARENT** (you can see through it) so we know exactly what they are looking at.

Can you spot the objects on these scientists' benches that match the descriptions below?

1. The liquid was very bright, colourful and **opaque**.
 2. The hammer was made from a very **bendy** material.
 3. The girl's scarf was very **stiff** and difficult to wear.
 4. The wrapping paper was **transparent** so I could see the present inside.
 5. The cushion was made from a very **rough** material so it was uncomfortable to sit on.
- (Answers on page 36.)



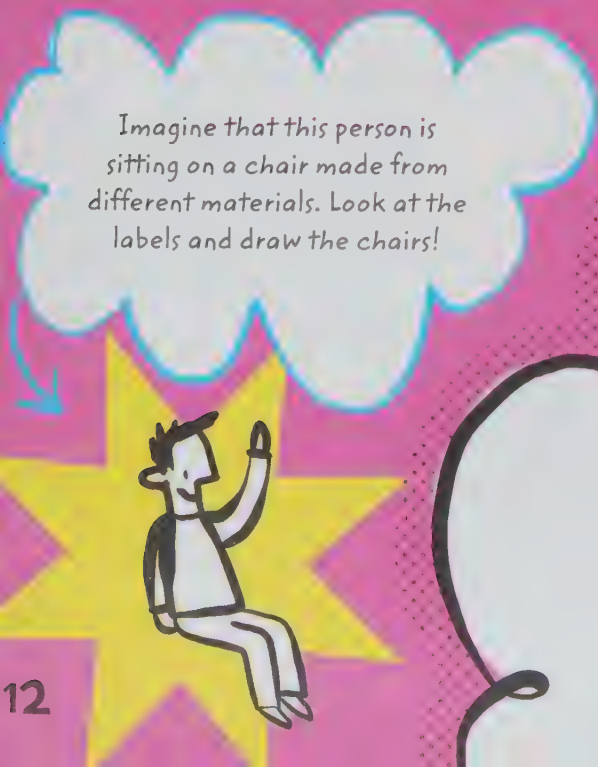


TWIST AND SHOUT

Materials that objects are made from have their own characteristics. These characteristics are a bit like their personality and help us to decide what to use them for. For example, some materials are very easy to squash or squish or twist and other materials are very hard to squash or squish or twist.



Imagine that this person is sitting on a chair made from different materials. Look at the labels and draw the chairs!



Chair made of stone



Inflated beach ball chair



Chair made of cake

CHANGING STATE

The characteristics of a material can change.

Water becomes snow or ice under **0 degrees Celsius** and it becomes steam very quickly over **100 degrees Celsius**.



Draw this glass of water (with lemon wedge to make it fancy!) next to the temperatures below. What state will the water be in?

(Answers on page 36.)



ICE



WATER



STEAM

$^{\circ}\text{C}$ = degrees Celsius

$^{\circ}\text{F}$ = degrees Fahrenheit

$-10^{\circ}\text{C} / 14^{\circ}\text{F}$

$35^{\circ}\text{C} / 95^{\circ}\text{F}$

$18^{\circ}\text{C} / 64.4^{\circ}\text{F}$

$101^{\circ}\text{C} / 213.8^{\circ}\text{F}$

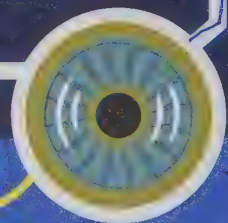
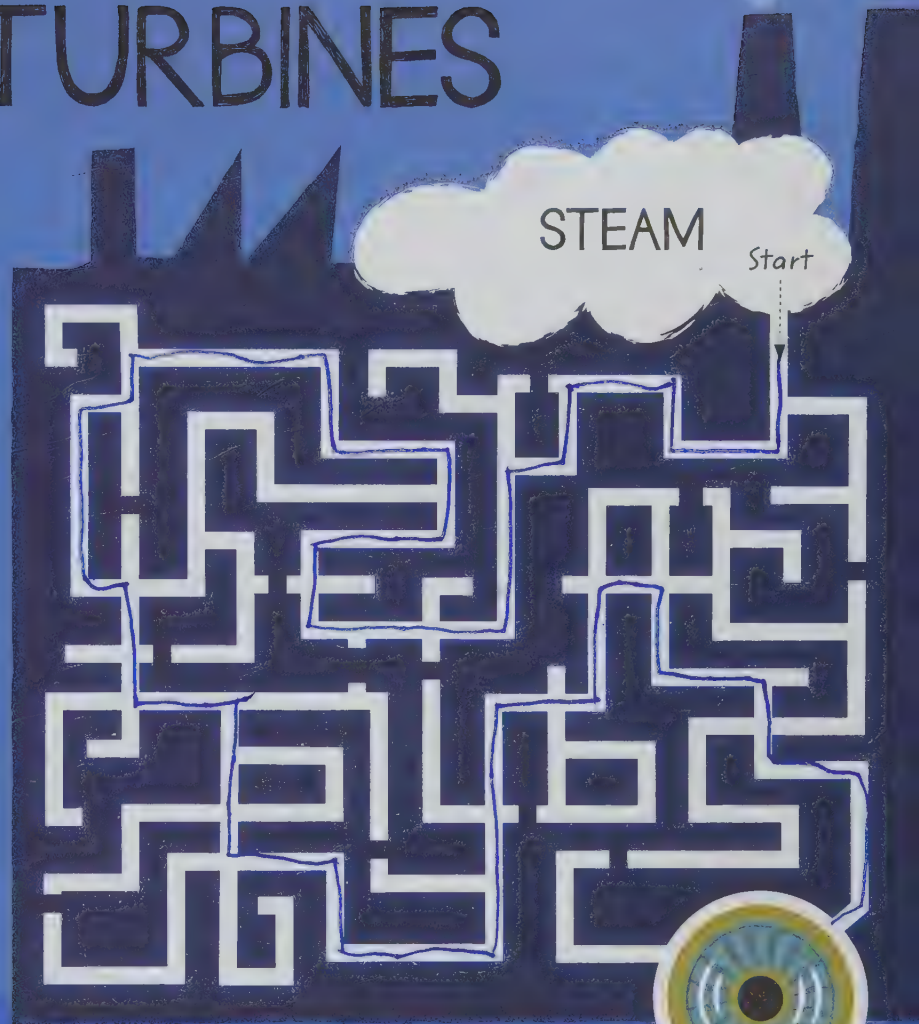
TURNING TURBINES

The turbines in power plants spin to create electricity. The people who run power plants use different ways to make the turbines spin but the most popular method is to use steam. You will see on the following pages the different ways of creating steam in power plants.

The electricity generated by the turbines then travels along power cables to your home and gives power to your electrical devices.

Find your way through this maze as steam helps create electricity.

(Answer on page 36.)



Turbine



OLD ENERGY

Coal, gas and oil are made from plants and animals that died a long time ago and have been buried under soil and rocks ever since. Once these fuels have been burnt to make steam in power plants they cannot be used again. They create pollution that harms the environment.

Spot 10 differences between these scenes showing oil reserves at the bottom of the sea.

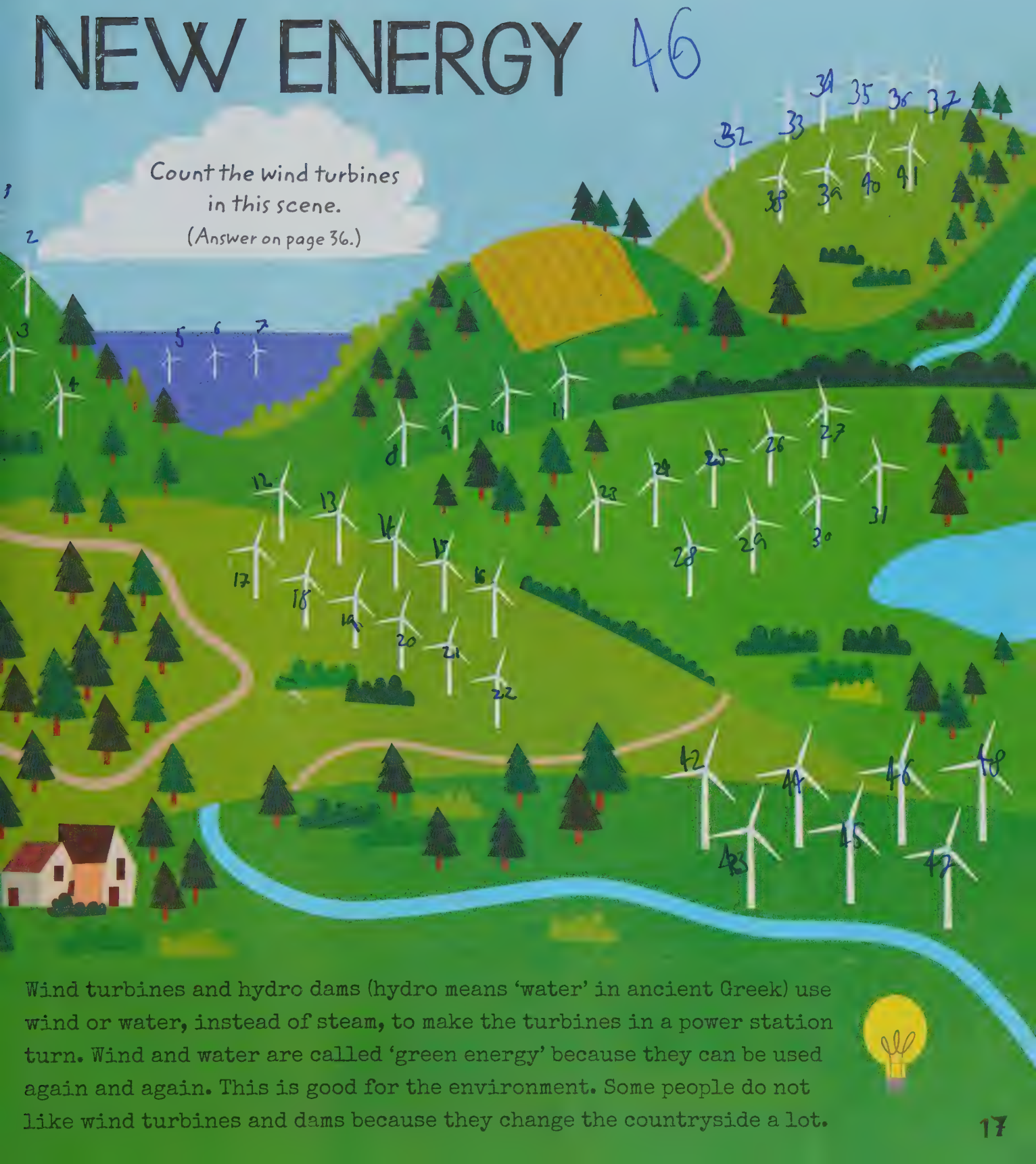
(Answers on page 36.)



NEW ENERGY 46

Count the wind turbines
in this scene.

(Answer on page 36.)



Wind turbines and hydro dams (hydro means 'water' in ancient Greek) use wind or water, instead of steam, to make the turbines in a power station turn. Wind and water are called 'green energy' because they can be used again and again. This is good for the environment. Some people do not like wind turbines and dams because they change the countryside a lot.



SUN POWER

Solar panels (solar comes from the Latin for sun) create heat from the sun's energy. This sort of energy is popular because it does not cause pollution or damage the countryside. You need a lot of space and a lot of sun to make enough energy from solar panels.



Try to answer these multiple choice questions about solar energy. The answers are on page 36.

3. ONE OF THE BIGGEST BENEFITS OF USING SOLAR POWER IS:

- a) THE PROCESS DOES NOT CREATE MUCH POLLUTION.
- b) THE SOLAR PANELS LOOK COOL.
- c) YOU CAN BOAST ABOUT THEM TO YOUR FRIENDS.

1. SOLAR POWER PROVIDES A LARGE AMOUNT OF THE WORLD'S ENERGY.

- a) TRUE
- b) FALSE

2. WHICH OF THESE EXPLORER'S VEHICLES COMMONLY USES SOLAR POWER TO CREATE ENERGY?

- a) SUBMARINE
- b) SPACECRAFT
- c) HELICOPTER
- d) MOTORBIKE

4. WHICH OF THESE LOCATIONS ALREADY HAS SEVERAL LARGE-SCALE SOLAR POWER PLANTS?

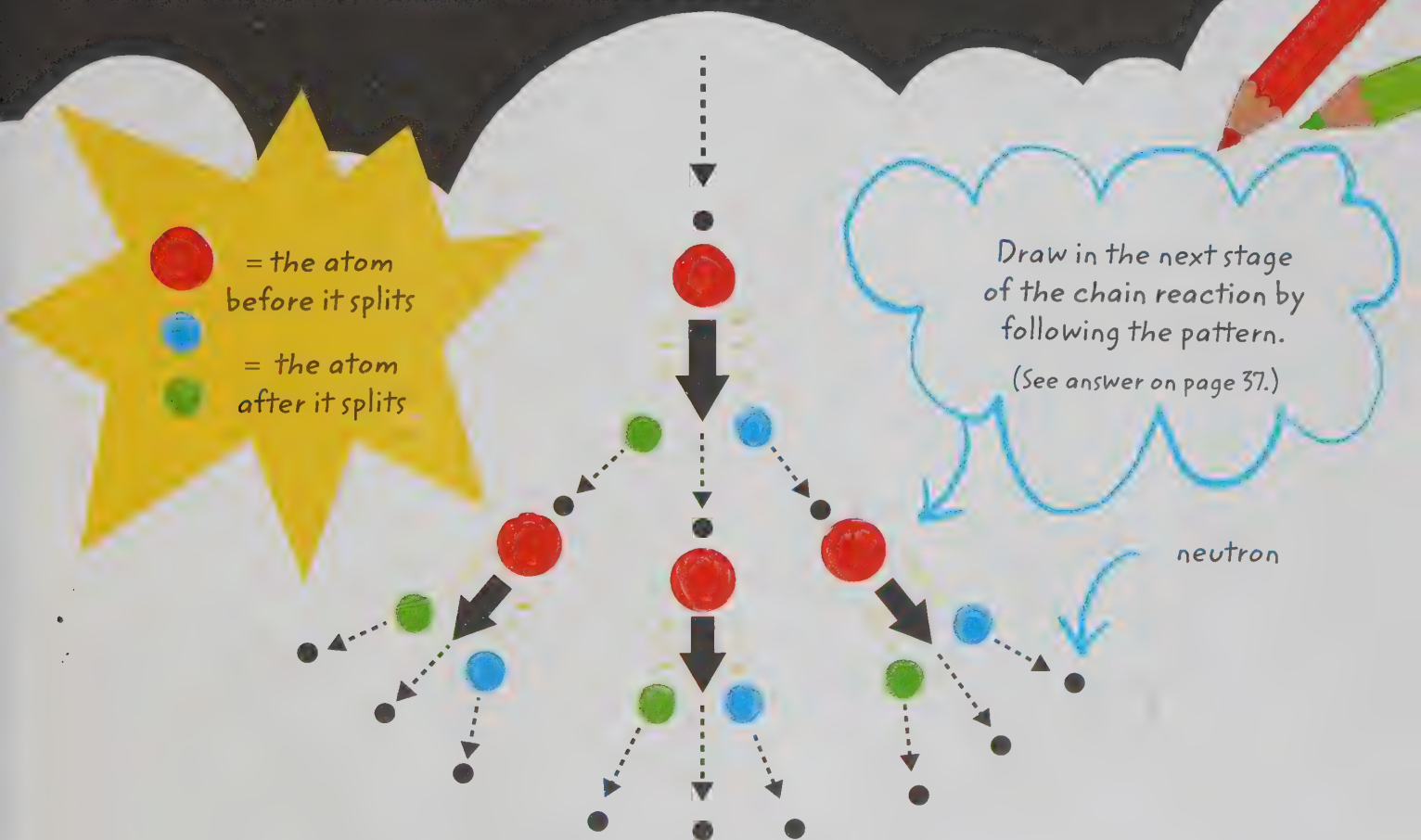
- a) WALES, UK
- b) SIBERIA, RUSSIA
- c) CALIFORNIA, USA

5. SOLAR POWER COMES DIRECTLY FROM SUNLIGHT. THE SUN IS:

- a) A STAR
- b) A PLANET
- c) A GALAXY

NEW AND NUCLEAR

Nuclear reactors split atoms in order to generate the heat that turns water into steam which then turns turbines just like in other power plants. Atoms are made of smaller particles called protons, neutrons and electrons. Scientists fire neutrons at uranium atoms to split them, releasing more neutrons and energy. The process continues and is called a chain reaction. Nuclear reactions do not use fossil fuels but do create radioactive waste which is very harmful to humans and other creatures.



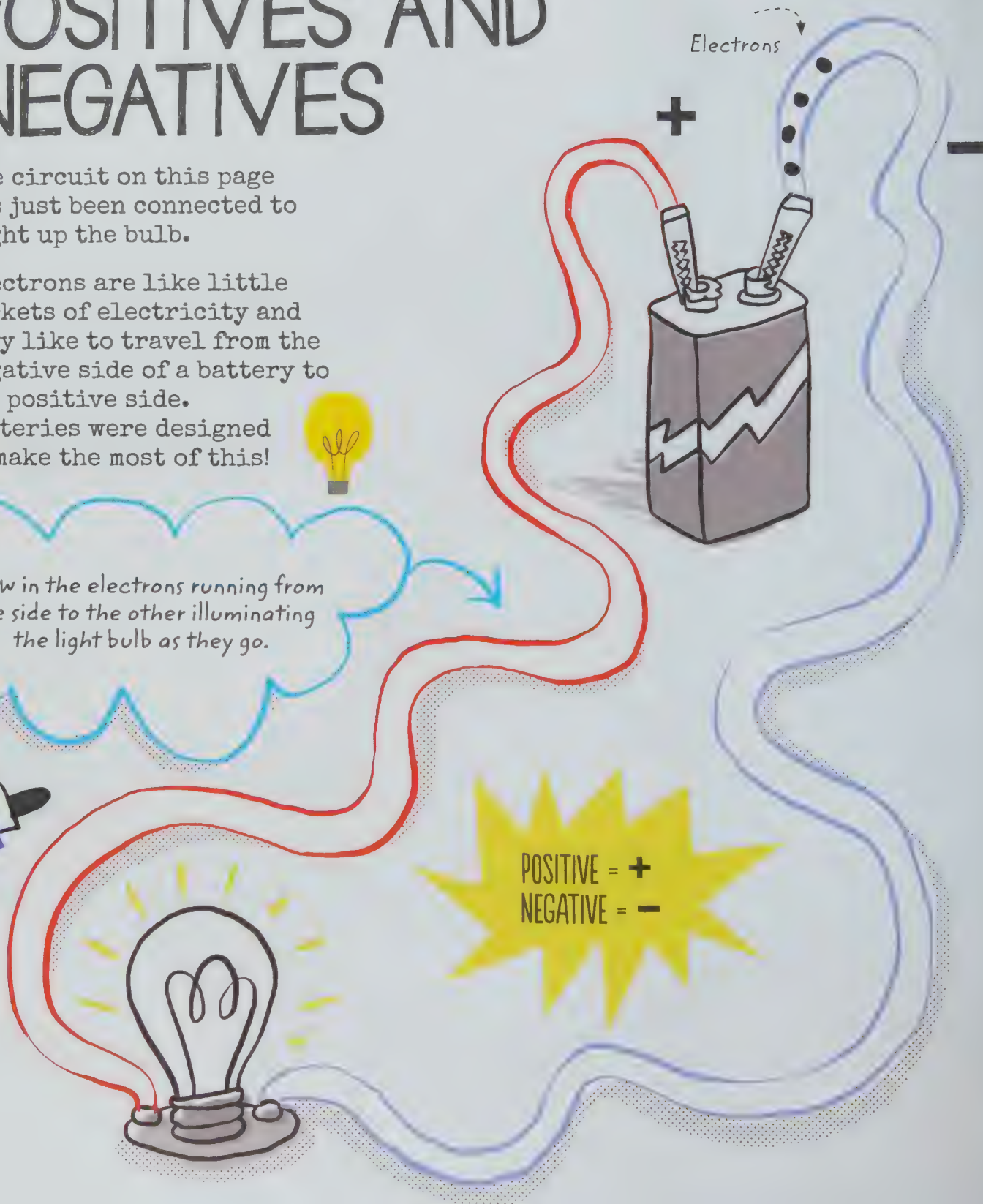
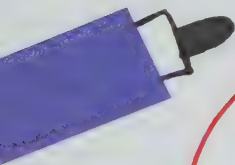
POSITIVES AND NEGATIVES

The circuit on this page has just been connected to light up the bulb.

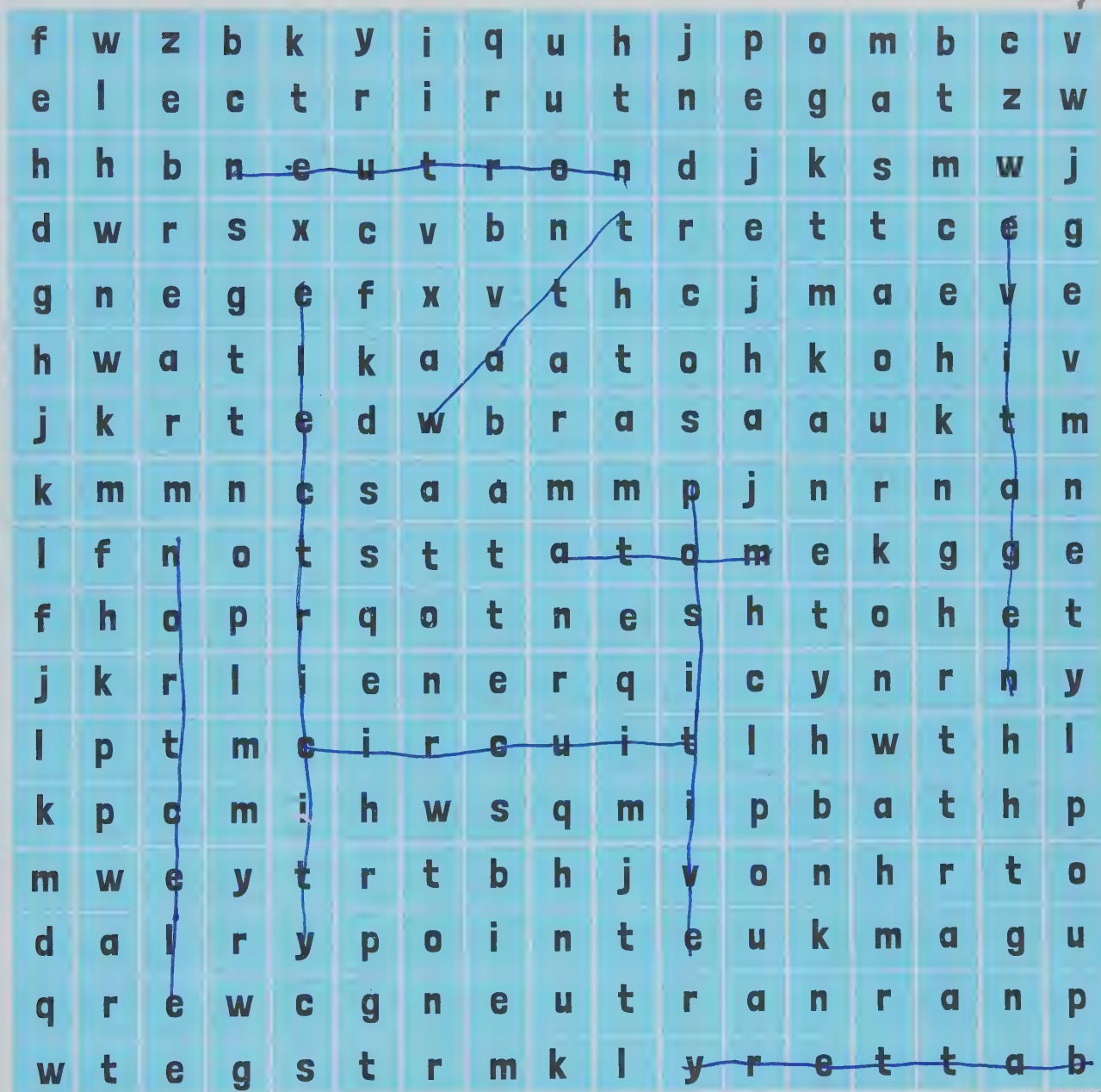
Electrons are like little packets of electricity and they like to travel from the negative side of a battery to the positive side. Batteries were designed to make the most of this!



Draw in the electrons running from one side to the other illuminating the light bulb as they go.



Find the electrically charged words in this word search.



atom

neutron

electron

electricity

charge

positive

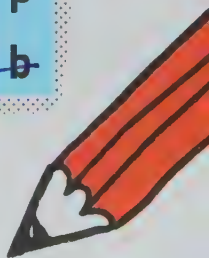
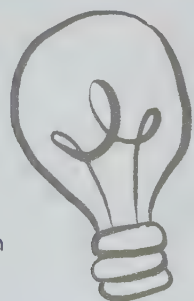
negative

circuit

battery

watt

Answers on
page 37.



STORMS OF ELECTRICITY

Thunder is the sound that lightning makes. You can hear thunder because your ears pick up the vibrations that lightning makes when it strikes. If the storm is close then you can see the lightning and hear the thunder almost at the same time. If the thunder follows a few seconds afterwards then the storm is further away and the vibrations have to travel further in order for you to hear them.

Lightning happens in the first place when small bits of ice bash into each other in a thundercloud creating positive and negative electric charges. As you saw on page 20, electricity travels between negative and positive charges. This electricity sparks between the two charges inside the clouds or, more rarely, sparks between the cloud and an object on the ground, such as a tree or a building. This is lightning.





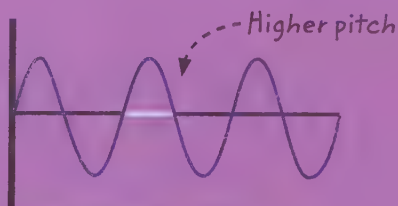
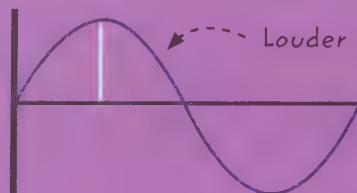
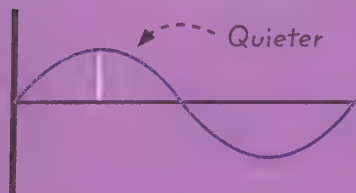
Search in this scene
for the following
things:

- LIGHTNING FORK
WITH FOUR PRONGS
- A FLOWER WITH
SIX PETALS
- TWO RED UMBRELLAS
- A CAR WITH A BROKEN
WINDOW
- THREE LITTLE BIRDS
- A CAT
- A TRACTOR
- A CUPCAKE

(Answers on page 37.)

WAVES OF SOUND

Sound waves are made by vibrations. The type of sound that you hear depends on the frequency and amplitude (size and height of the sound wave) and what the sound has to travel through to reach you.



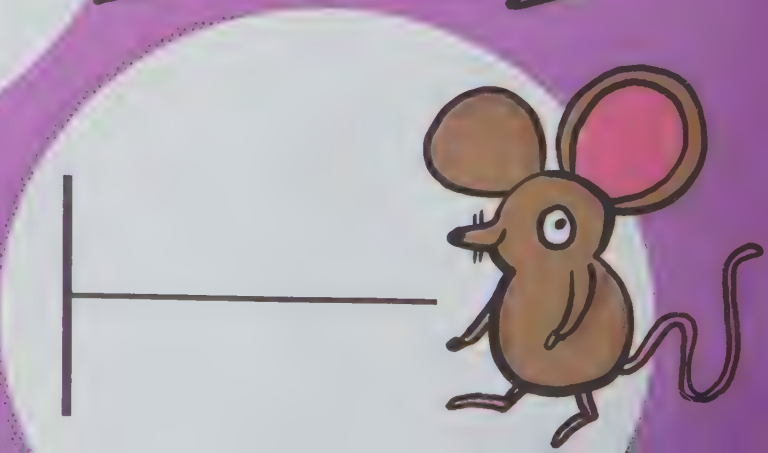
Using the key, draw the sound waves to go with these sounds. The pitch is the type of sound.

(Answers on page 37.)

LION'S
ROAR



MOUSE'S
SQUEAK



FIGHTER
JET



WHALE SONG



FART

ROCK CONCERT



YOU TALKING
QUIETLY



YOU SHOUTING

SHADOW MAGIC

When there is something between an object and light then that thing casts a **shadow**.

The sun is our main source of natural light and during the day light reflects off objects and into our eyes so that we can see them. Darkness is the absence of light and this means that we cannot see what is around us. Shadows are examples of darkness that we can see.



Our shadow can be long and tall or short and small depending on where the sun is in the sky.

Match these dog owners with their pets using their shadows.

Can you guess where the sun is coming from for each shadow?

If so, add an arrow.

(See answers on page 38.)



Indoors when it is dark, you can use a torch to create shadows with your hands. There are lots of fun animals that you can recreate! Have a go at making these.

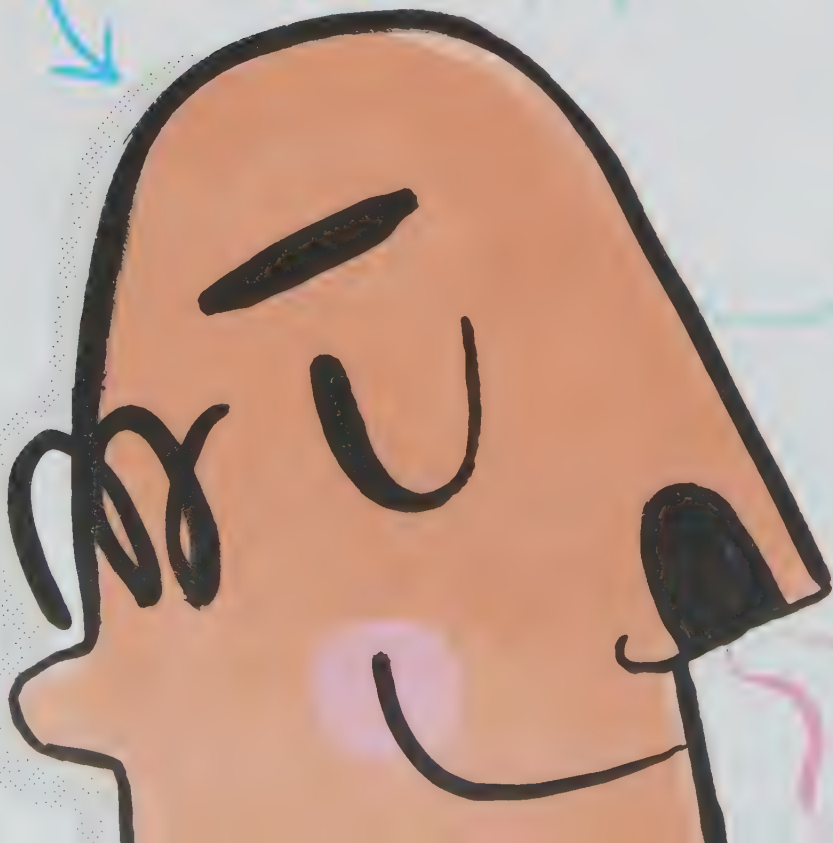


WHAT A WHIFF!

Smells travel in the air.
The smells are made up of
chemicals. When you breathe
them in, the chemicals
tell your brain what
you are smelling.



*Choose what these people are smelling.
Is it nice or is it nasty?
Draw it in the thought bubbles.*





GOOD TASTE

There are thousands of taste buds on your tongue. The food you eat reacts with the buds so that you can taste what you are eating.



Colour in this picnic using the following key:

Sweet foods = red
Salty foods = blue
Sour foods = yellow
Bitter foods = green

(Answers on page 38.)



Can you find these objects in this order somewhere else on the page?



Answer on page 38.



TOUCHING TRUTH

Touch a few things around you now. When you touch something, nerve endings in your skin send information to the brain. They tell you about temperature, how much something hurts and how much pressure you are feeling. Each part of your body communicates with its own part of the brain so that you know exactly where you are feeling something.



A hand-drawn diagram for a sensory experiment. It features six light blue rounded rectangular boxes arranged in a grid, each with a label and an arrow pointing to an illustration. The top-left box is labeled 'NAILS' and points to four black nails. The top-right box is labeled 'ICE' and points to a blue ice cube melting on a white puddle. The middle-left box is labeled 'RABBIT' and points to a brown cartoon rabbit. The middle-right box is labeled 'JELLY' and points to a pink jelly mold on a yellow plate. The bottom-left box is labeled 'FIRE' and points to a campfire with orange and yellow flames. The bottom-right box is a pink cloud shape containing text.

NAILS

ICE

RABBIT

JELLY

FIRE

Write down some words to describe how these things would feel if you touched them. Remember, never touch fire and be careful when touching other objects.

Fingerprints can be creative too!
Turn these prints into
little creatures.



OPPOSITES ATTRACT

Magnets attract metals that have iron in them, like steel and nickel. Materials such as wool, glass, wood or plastic are not magnetic. Magnets have a north pole and a south pole. The north pole will ATTRACT $\rightarrow\leftarrow$ south poles from other magnets but it will PUSH AWAY $\leftarrow\rightarrow$ north poles. The south pole attracts north poles and repels south poles.



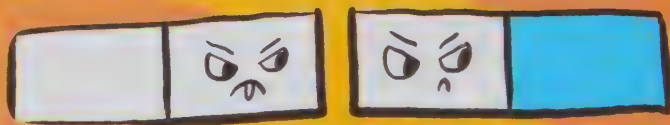
Colour the north poles of these bar magnets red and the south poles blue. You can tell which is which by looking at whether they are attracting each other or pushing each other away.

(Answers on page 38.)



= NORTH

= SOUTH



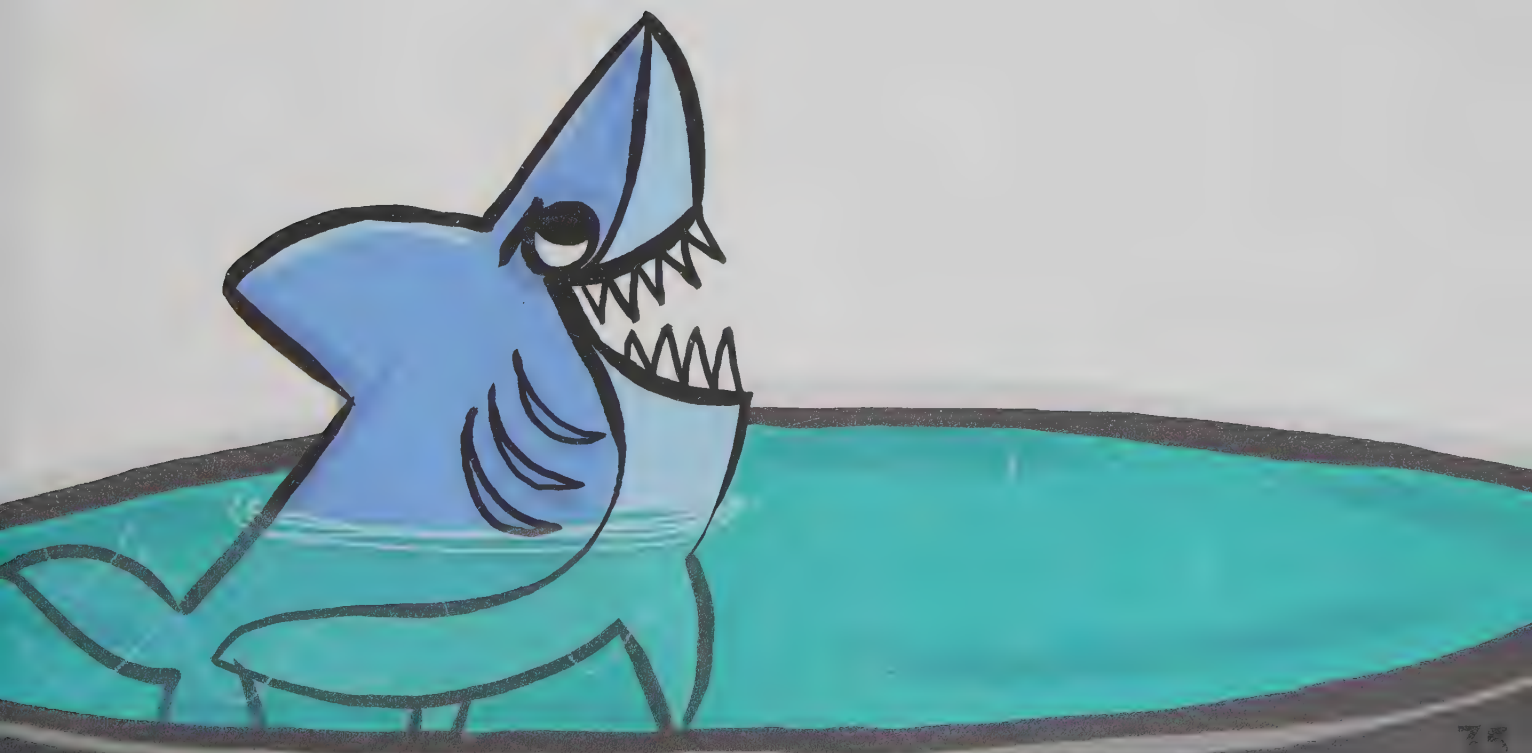
Imagine that you have thrown these things at the very strong magnet above the shark tank. Which ones will stick to the magnet and which ones will fall into the shark tank?

Draw them on the page.
See page 34 if you are not sure.



A SHEEP
A KEY
A T-SHIRT
A CAR
A FRIDGE MAGNET
A CAKE

(Answers on page 38.)



ANSWERS

Pages 10-11



Page 16



Page 17

There are **48** wind turbines in the scene.

Page 18

1. b) False
2. b) Spacecraft
3. a) The process does not create much pollution
4. c) California, USA
5. a) A star

Page 14



-10°C
14°F

18°C
64.4°F

35°C
95°F

101°C
213.8°F

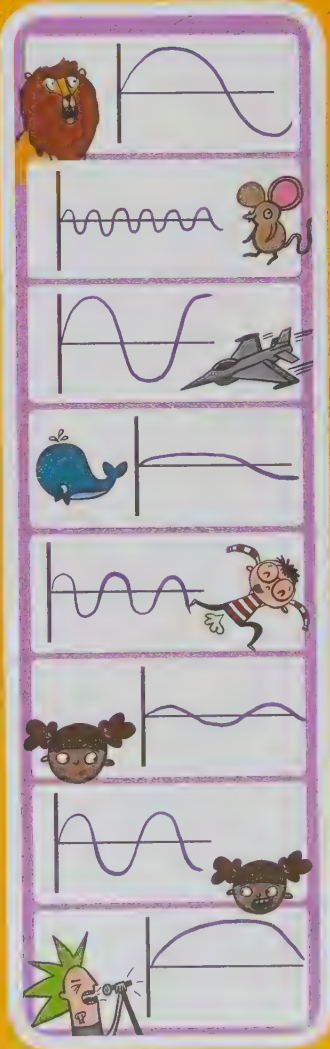
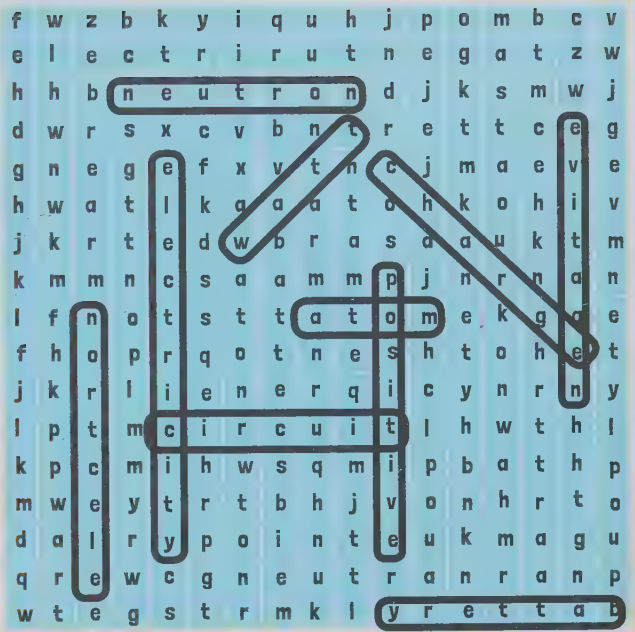
Ice Water Water Steam

Page 15

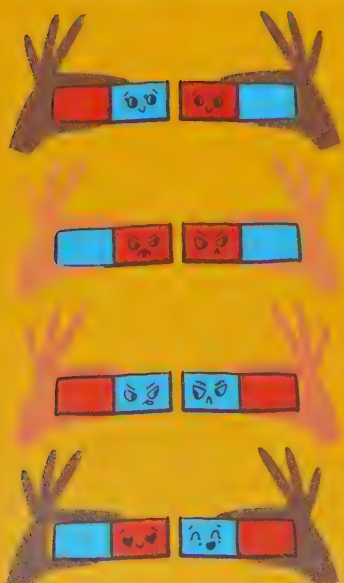




...and so on!



These answers just show the type of sound wave you can draw.
So your one might look a bit different!



MAGNET:

- a key
- a car
- a fridge magnet

SHARK TANK:

- a sheep
- a T-shirt
- a cake



TECHNOLOGY ACTIVITY Book



UNDER PRESSURE

We use taps to turn the water on and off in our homes. The taps are attached to the hot and cold water pipes. Inside each tap are two discs with holes in them. When you turn the tap, the discs slide across each other to open or close the holes. The water in the pipes is under pressure. This means it is pushing against the discs in the tap. So when the discs line up and the hole opens, it gushes out.



Follow this safe drinking water on its journey from tap to plughole.



TOILET TROUBLES

The modern toilet means we can flush away our wastewater (poo and wee) safely and keep our neighbourhoods clean and free from disease. In the past, wastewater would be thrown into the streets and it was impossible to stop horrible smells. Now when you flush the toilet, the water rushes into the bowl and clears out the wastewater. This runs along pipes out of the house, under the street and to a special sewage treatment centre. This treats the water until it's clean enough to go back into the rivers again.



1. When is World Toilet Day?

- a) 9th August
- b) 19th November
- c) 1st April
- d) 17th October

2. On average, how many years of your life do you spend on the toilet?

- a) half a year
- b) three years
- c) five years
- d) twelve years

3. What did the Vikings use instead of toilet paper (which hadn't been invented yet)?

- a) a wide stick
- b) big leaves
- c) sheep's wool
- d) animal skins

5. What else does the technology used to make toilet brushes also make?

- a) artificial trees
- b) toothbrushes
- c) rulers
- d) plastic jewellery

4. Which of these things carries more germs than an average toilet seat?

- a) mobile phone
- b) computer keyboard
- c) washing up sponge
- d) pet food bowl



CATCH!

Medieval castles and cities were defended by big, strong walls. Before the invention of gunpowder, catapults were the best weapon to attack a city or castle. The arm holding the stones is held down, under tension, so it is trying to pull away from whatever is holding it down. When the tension is released, the arm swings round and shoots out the stone. Catapults could shoot heavy stones and even rotting animal bodies!



Draw the curving path, or trajectory, of each missile being fired from these catapults. Choose different missiles and see if any of them will hit the castle under siege.

(Answers on page 66.)





SPIN CYCLE



Have you tried washing any clothes by hand? It's very hard work. In the past, women were expected to do most of the household laundry so washing machines made a big difference to their daily lives. Washing machines automatically fill up with water, add soap powder or liquid, heat up the water, jumble the clothes around so the dirt falls off, rinse them several times and then spin them to dry them as much as possible.



Machines wash a lot more clothes than you could do by hand. Can you match these pairs and find the odd socks?
(Answers on page 66.)



ZIPPING ALONG



Finish off this zip.
Then decorate the
pencil case.

On either side of a zip is a row of links. These links are exactly the same size and exactly the same space apart so you can count: link, space, link, space, link, space and so on. One side of the zip starts with a link at the bottom and the other side starts with the space at the bottom so when you zip up your coat the slider (the piece you hold) joins the links together.

Before zips were invented at the beginning of the 1900s, clothes were fastened with buttons or hooks-and-eyes and it took a lot longer to dress. Rich people even had servants to help them get dressed! Now there are even airtight zips for deep-sea divers or space suits. This is an example of how simple technology can really change people's lives.

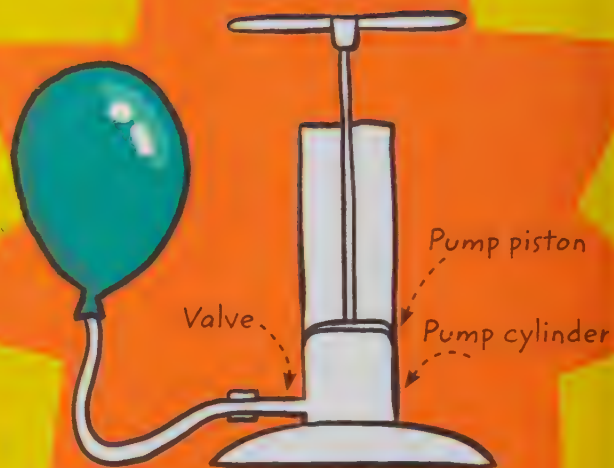


Colour in all the outfits that need zips. Check your artwork on page 66.

HUFF AND PUFF

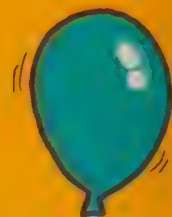
When you pull out the handle of a pump, it draws in air. Then you push the handle in and the air is pressed down, or compressed, at the bottom of the tube or chamber.

The pressure of the air opens a small valve, like a little gate, and the air rushes out through a narrow tube at a high speed. This blows up the ball...or the balloon or the bike tyre.



Unravel this mess of pump tubes to find out who is pumping up their balloon the quickest.

(Answer on page 67.)



Spot 20 differences between these two scenes. The family on the bottom need a new pump!

Check your answers on page 67.



BRIDGING THE DIVIDE



Truss Bridge

Arch Bridge

Beam Bridge

Cable Stayed Bridge

There are lots of different types of bridges. Can you get this family from their home to the beach, crossing every bridge only once?

(Answer on page 67.)



Suspension Bridge

Cantilever Bridge

Tied Arch Bridge

Bridges work using compression and tension. Compression is the force used when you push something together. Tension is the force used when you pull something apart. If you get the right amount of each of these things then you can create a very strong structure. Bridges use their own weight in different ways to stay up. It's a clever balancing act.



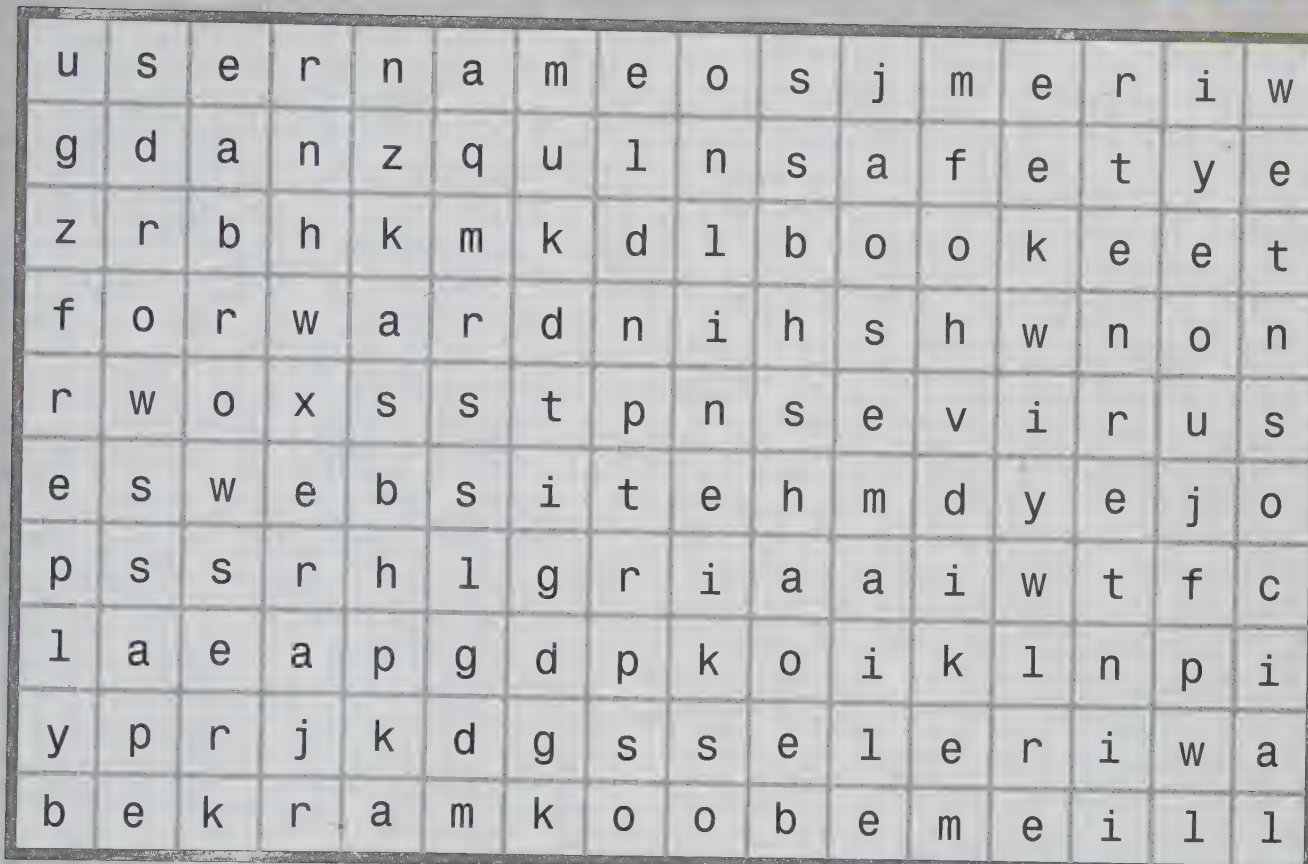
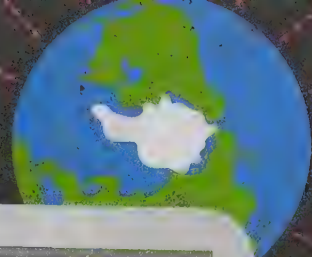
THE WORLD WIDE WEB

What do you think
the internet looks like?
Draw it here.

The internet is the way computers are connected to each other all over the world. They might be linked by wires or without wires, called wireless. You can use the internet to send email messages, chat online and make phone or video calls. You can also search for information on the web or world wide web (www). These are pages of information linked together by the internet. You find those pages through a web browser.



Can you find these internet-related words in the puzzle below? See page 68 for the answers.



website

bookmark

online

social

browser

wireless

virus

share

address

email

forward

username

internet

safety

reply

password

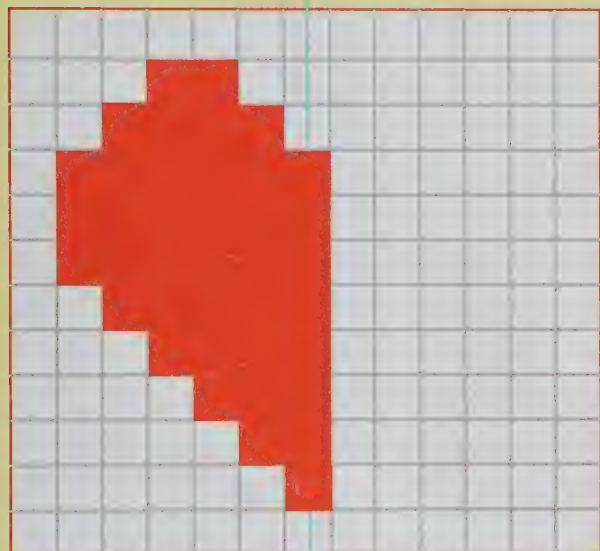
SNAPPY CHALLENGE

Before the invention of digital cameras, if you wanted a portrait of yourself or your favourite pet, an artist had to paint it for you. Early cameras were very large and heavy and took ages to take the photo. Now digital cameras are small and light and you can take photos with a tiny camera in a mobile phone. 



Draw a selfie!

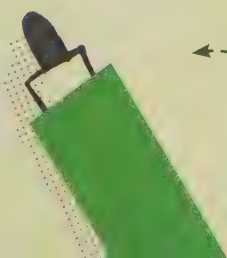
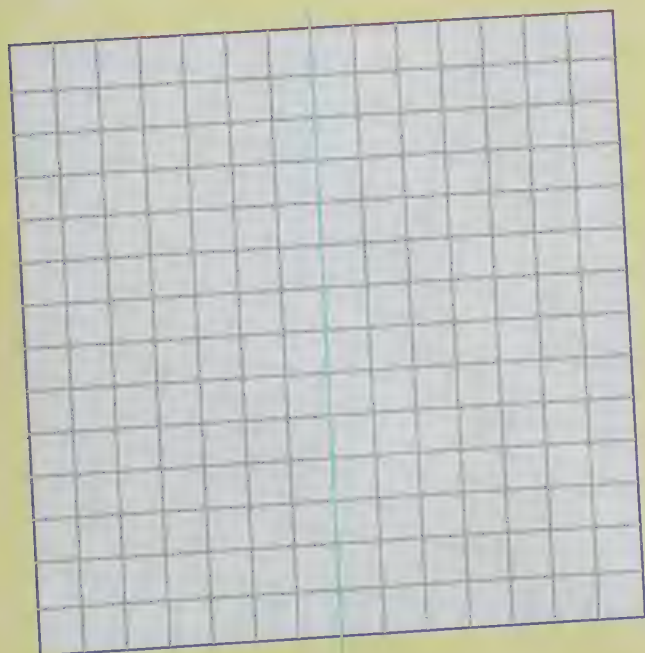
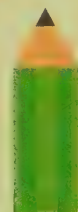
When you point your camera at something, light travels from the scene or object you are photographing into the camera through a lens. This light then hits a sensor, which is divided into millions of little squares, called pixels. Each pixel represents a different colour or brightness. The computer in the camera converts the pixels into a picture.



Images that look smooth are actually made of lots of squares (pixels).

Finish off these images.

(See answers on page 68.)



Use this grid to make your own design.

TALKING ON THE TELEPHONE

Before telephones were invented, if you wanted to talk to someone, you had to go to their house or meet them somewhere face to face. Now you can talk to friends on the other side of the world just by picking up the phone.

Can you work out who is talking to who?

WHERE ARE YOU?

HOW'S THE EXPEDITION GOING?

DID YOU FIND THE BUS STOP?

WHAT'S THE WEATHER LIKE WHERE YOU ARE?

ARE YOU AT YOUR MUM'S OFFICE TODAY?

YES, IT'S UP ON THE SIXTH FLOOR.

ARE YOU WITH THE CHILDREN?

CAN YOU GIVE ME THE ADDRESS FOR THE SATNAV?

OK, YOU'LL SEE WE ARE THE ONLY HOUSE ON THE HILL



I'M NEARLY AT THE SUMMIT!

THERE'S SOME FANTASTIC WILDLIFE HERE.

I'M IN THE CABLE CAR.

IT'S REALLY SNOWY AND COLD.

WATCH OUT FOR THE ROCKS FURTHER UPRIVER.

I HOPE YOU'RE TAKING LOTS OF PHOTOS.

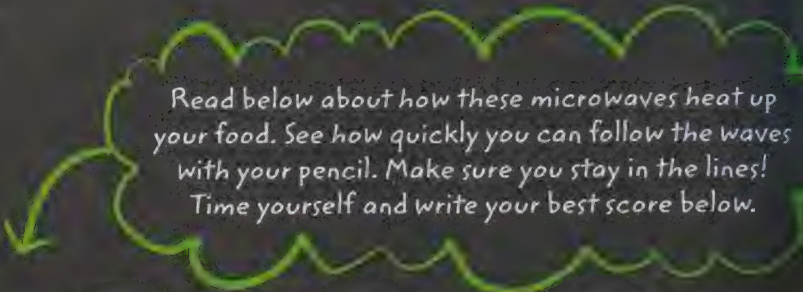
YES. DID YOU REMEMBER TO WALK THE DOG?

I'M ON THE BUS RIGHT NOW!

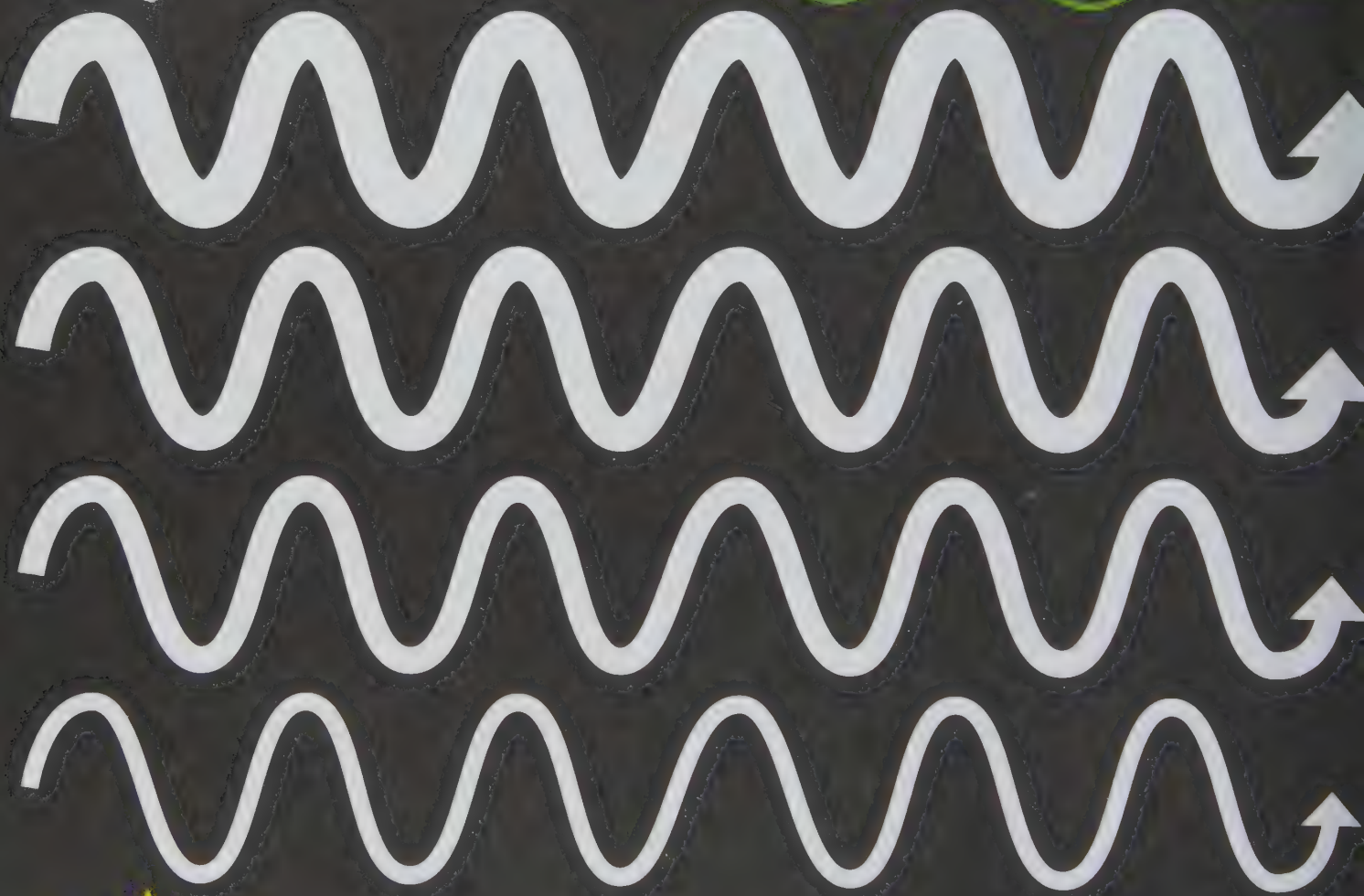
THANKS FOR THE WARNING.

When you speak into a mobile phone, it sends a microwave to a special mast and this mast transmits (sends) it on to the telephone exchange. The exchange turns it into a digital message to send on to the person you are speaking to, along a cable or sometimes by satellite. Your mobile phone won't work properly if there isn't a mast nearby so there are mobile phone masts everywhere. Look for them when you go out.

SHAKE IT UP



Read below about how these microwaves heat up your food. See how quickly you can follow the waves with your pencil. Make sure you stay in the lines! Time yourself and write your best score below.



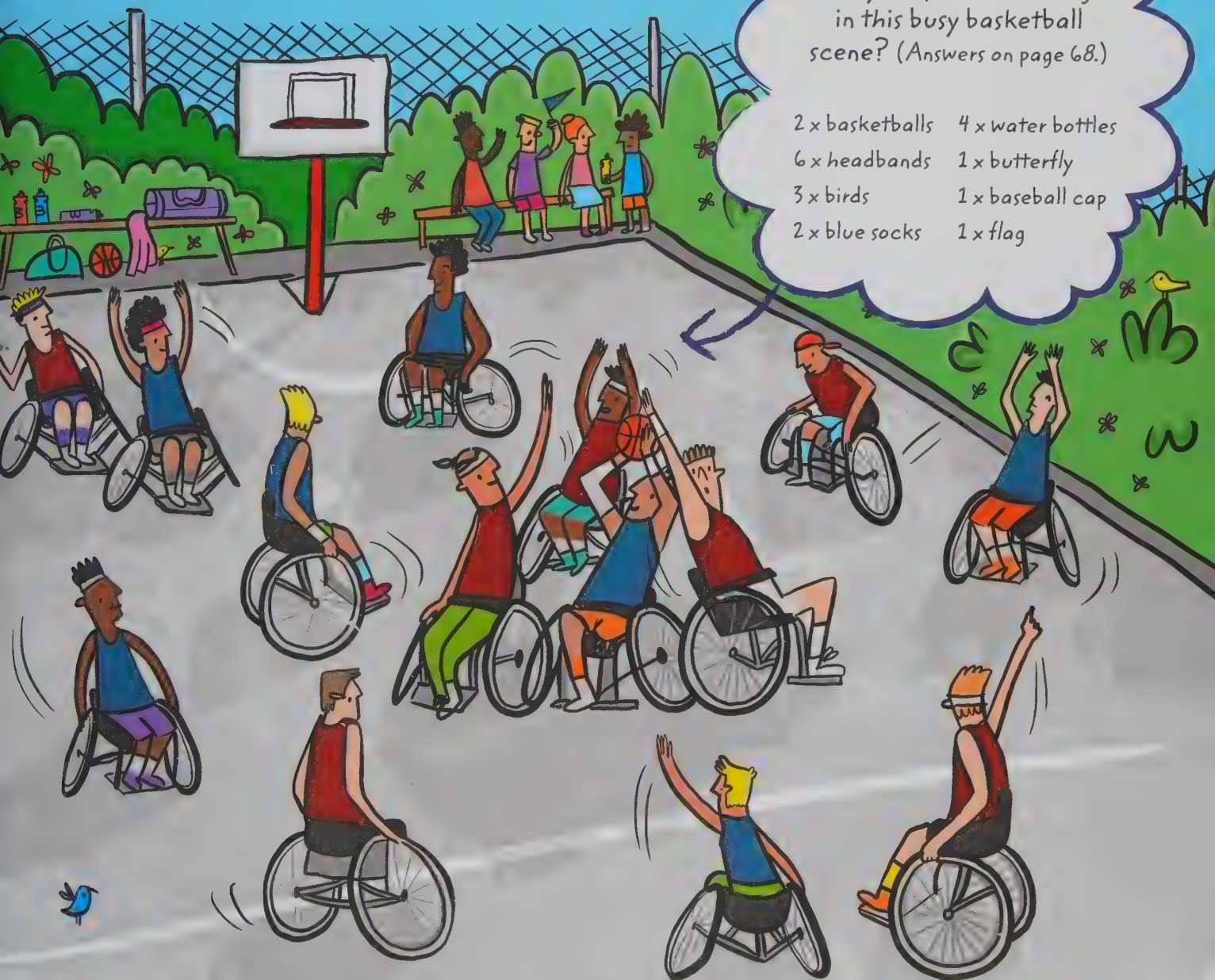
Microwaves are a type of radio wave. The wave wobbles the molecules in the liquid part of your food and, as the molecules jumble about and crash together, they heat up. Microwaves only travel in one direction. So that's why the food goes round and round on the tray in the oven, to make sure the microwaves pass through all parts of the food and cook it thoroughly.



WHEELY USEFUL

Can you spot these things
in this busy basketball
scene? (Answers on page 68.)

2 x basketballs	4 x water bottles
6 x headbands	1 x butterfly
3 x birds	1 x baseball cap
2 x blue socks	1 x flag

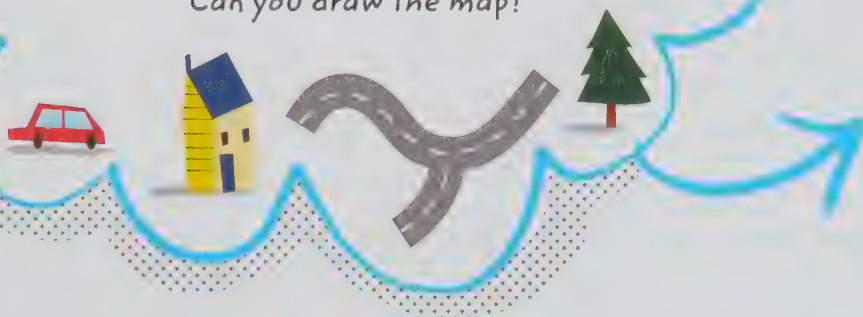


A wheelchair means that people who have difficulty walking can go to work, visit friends, go shopping and play sports. Wheelchairs can be electric and are powered by batteries. Some wheelchairs have large rubber wheels so they can go on snow or into water. Sports wheelchairs need to be much lighter than standard wheelchairs so the athlete can whizz around the court.



SATNAV KNOWS THE WAY

Think of the route from your house to your school.
Can you draw the map?



Explorers in ancient times sailed across the oceans using the sun, moon and stars to find their way. They didn't have accurate maps. In fact they drew the coastline of the countries they discovered and created the maps for the voyagers who followed them. Now maps are digital (the information is stored in a computer) and you can check your position on a phone or on a small computer in a car. This is especially useful for ships and aeroplanes. Satnav (satellite navigation) calculates your position from signals sent from satellites in space. The signal must come from at least four satellites to be accurate.



CHOCKS AWAY!

Air force pilots sometimes have to get out of their aircraft quickly to save their lives. They use an ejection seat. First, the pilot pulls a handle and the roof of the plane explodes off. A catapult then pushes the seat along some rails and out of the plane. Then a small rocket fires it away from the plane. Next a small parachute opens to slow the seat down. Finally the small parachute pulls the main parachute out and the seat is shot away so the pilot can float to earth safely.



This pilot has engaged his ejection seat! But these pictures are in the wrong order. Number them correctly.

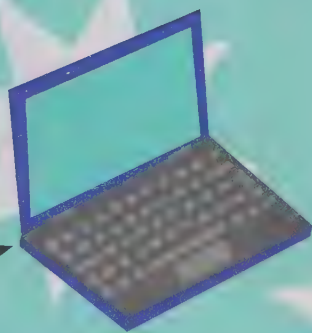
(Answers on page 68.)



OPEN AND SHUT

All these things have hinges so you can open and shut them easily. What can you find in your house that has a hinge?

Make a list below.
And watch your fingers!



A hinge connects two solid pieces so that they can rotate, or turn, away from each other smoothly. Look for other hinges around the house. We have types of hinges in our body too. Can you think where?



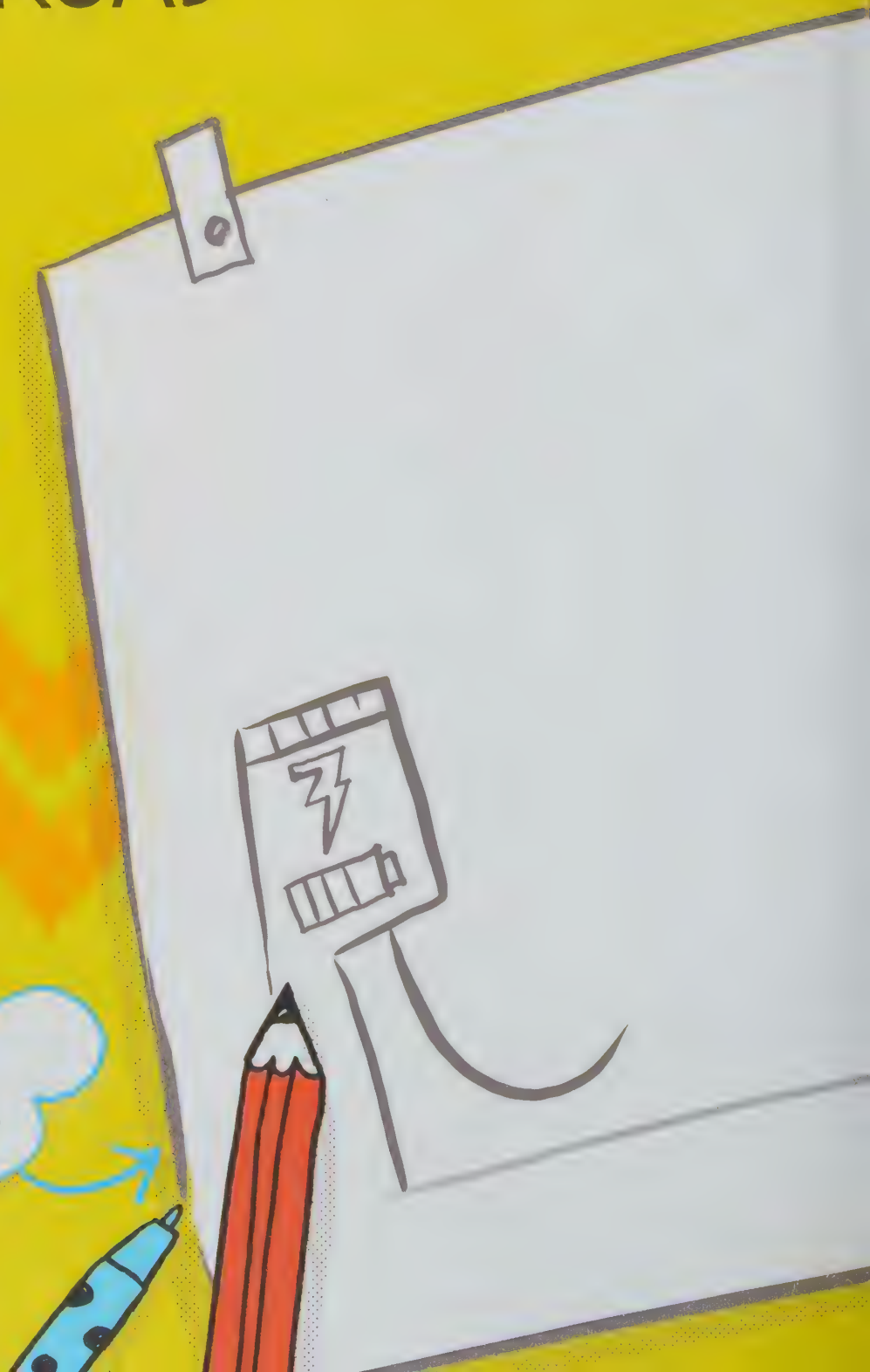
ON THE ROAD

Unlike petrol cars, electric cars don't pollute the air but they do need electricity to charge their batteries.

They are much quieter than petrol cars and much cheaper to run. They can't do long journeys without being charged but most people only do short journeys in their cars anyway. Cars that don't need drivers are coming soon! Can you imagine what they will look like?



Draw a fantasy car.
It's an electric car so you have to attach it to the electricity to power it up.





ANSWERS

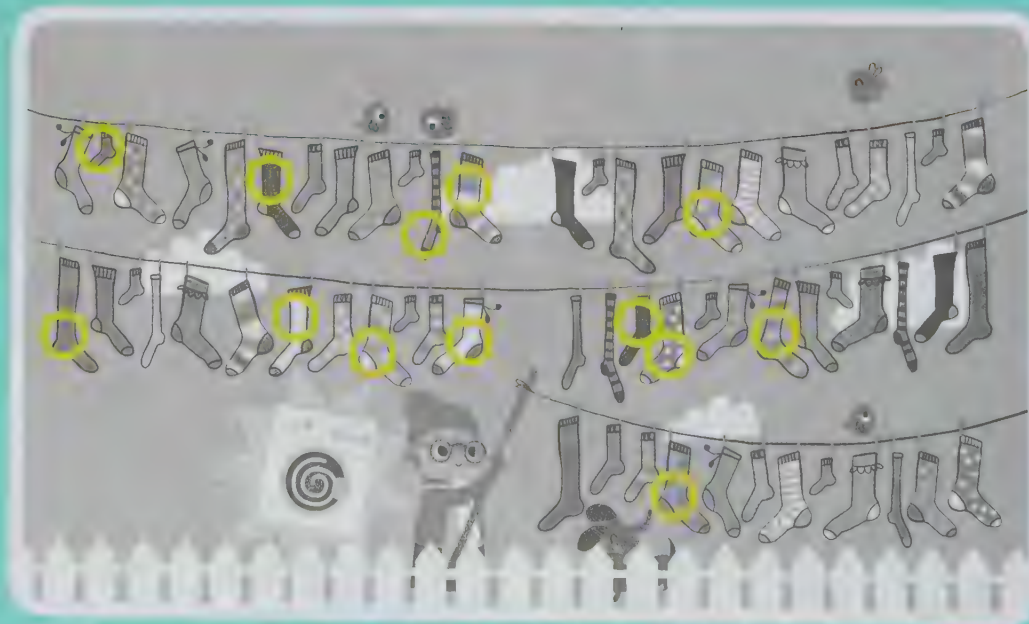
Pages 42-43

Page 41

1. b) 19th November
2. b) three years
3. c) sheep's wool
4. They all do!
5. a) artificial trees



Pages 44-45



Page 47

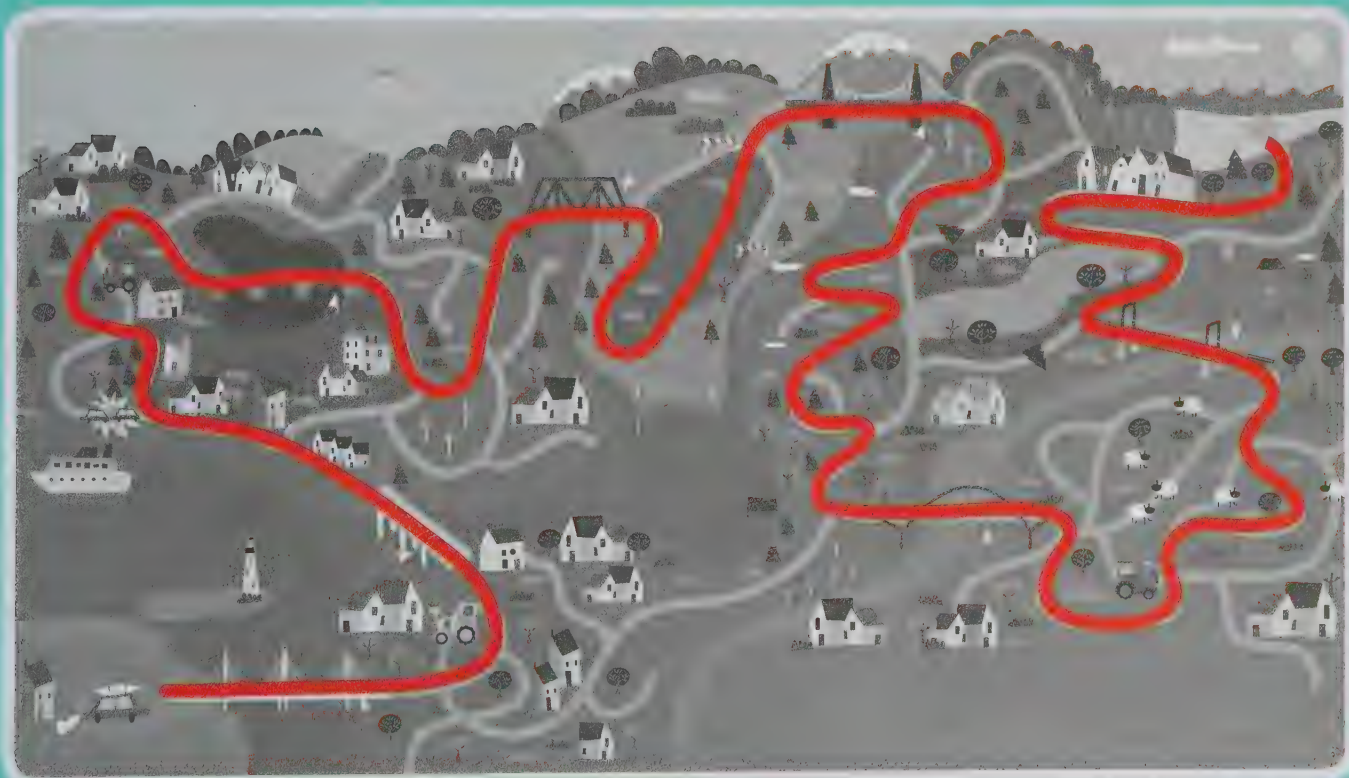


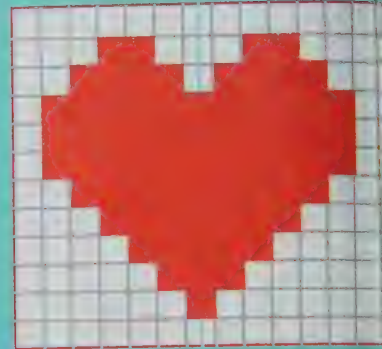
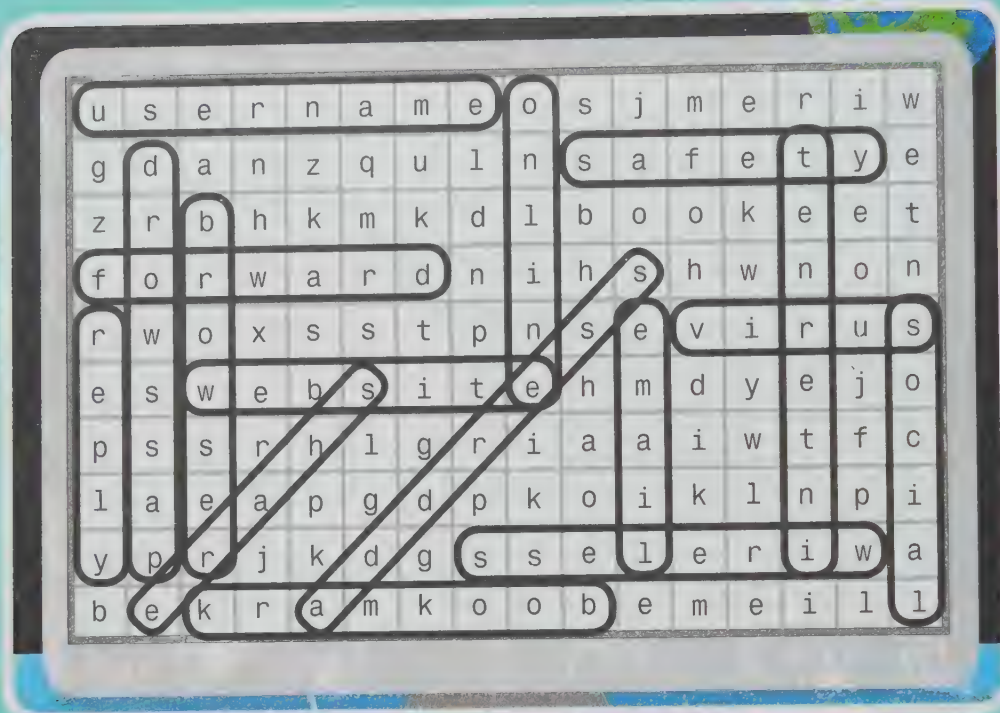


Page 48

Page 49

Pages 50-51





Page 55

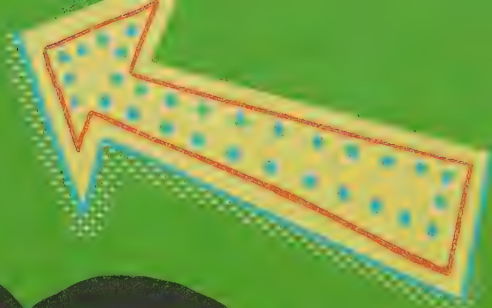


Page 53

Page 59

Page 62

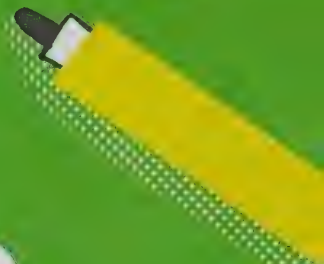
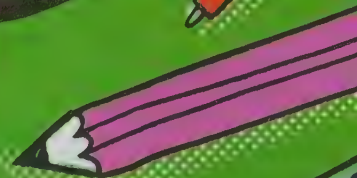




ENGINEERING

ACTIVITY

BOOK



PRINTING PRESS

Back in the Middle Ages, books were hand-written and then copied out (mostly by teams of monks). This meant there were very few copies of books, and each one was very expensive.

The engineer who solved the problem of books being such hard work to make was **Johannes Gutenberg**. His solution was 'moveable type' - lots of copies of each letter of the alphabet, made out of metal, which printers could combine in different ways in a printing press to make any number of copies of any text.

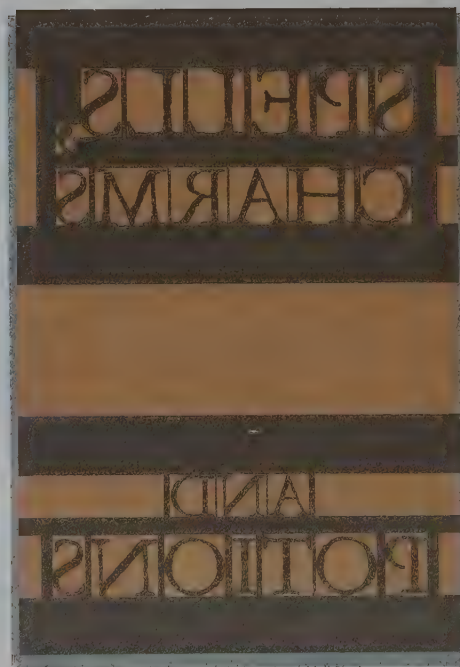
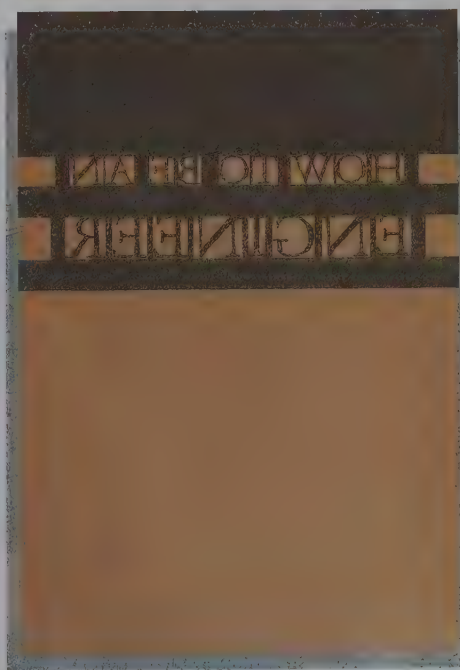
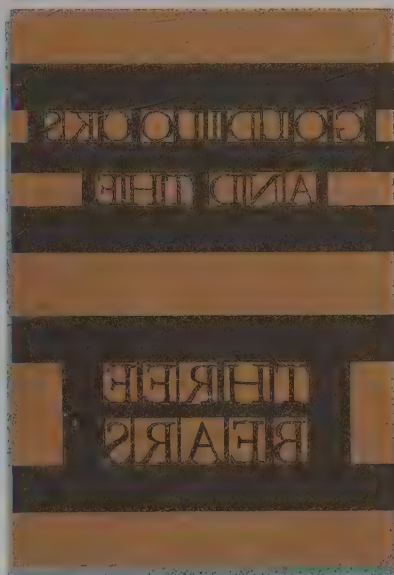


FACT!

Moveable type was used in Asia for hundreds of years before Gutenberg's invention, but because European alphabets are so much smaller than those in Asia, the invention was even more useful, so it spread very quickly across Europe.

Moveable type goes into a printing press **back-to-front**. This is so it appears the right way round when printed onto paper.

Look at these presses ready for printing — the writing is impossible to read! Use a mirror to see what the text will say when it is printed.



CYCLING ELECTRICITY

What is better than having lights on your bike when it's dark outside? Bike lights that don't need batteries to run! Some bikes have dynamo lights, which are machines that turn movement into electricity. The dynamo fixes to a moving part of the bicycle (the wheel or the hub) and as the wheel goes round, it turns the dynamo and that produces an electrical current. The electrical current gives power to the bicycle light.



The downside of dynamo lights is that the lights don't work when you're not moving!



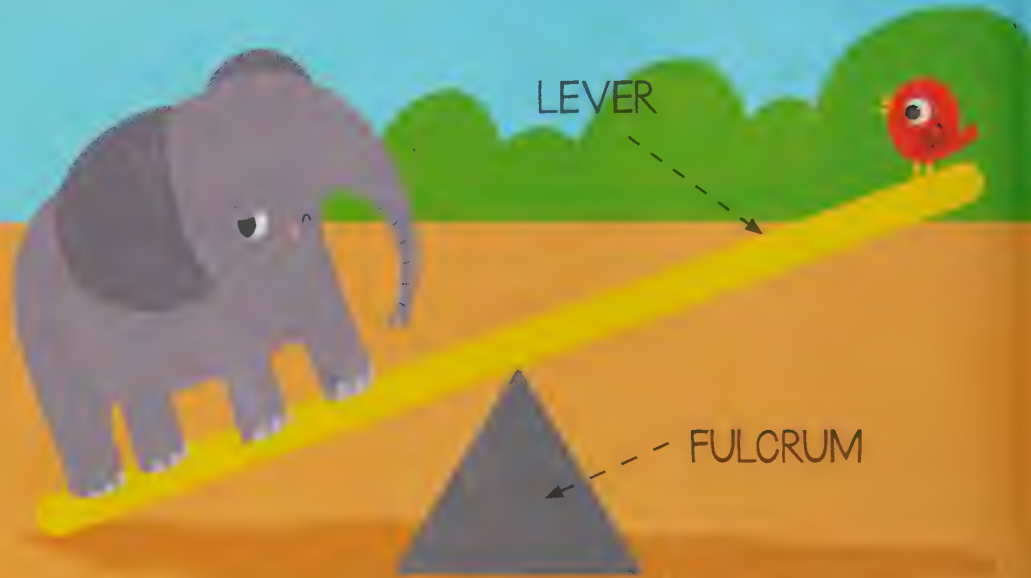
It's getting dark but this cyclist's lights are dynamos so she can see where she's going as long as the bicycle is moving. Help her find her way home using the cycle paths and avoiding anything that will make her come off her bike.

SEE-SAW LEVERS

Levers are one of the oldest machines in the world, and they help to lift things that would be too heavy to lift by yourself.

Levers need something called a 'fulcrum' to balance on. By changing the position of the heavy and light things along the lever, heavy things can be lifted more easily.

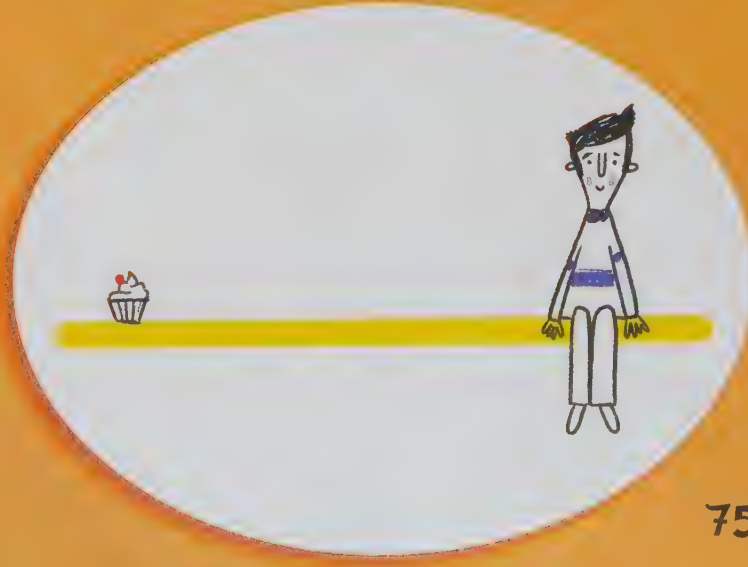
Something light can help lift something heavy if the heavy thing is close to the fulcrum and the light thing is far from it.



A fun kind of lever is the see-saw.
Heavy and light friends can play
together if they sit in the right places
on the see-saw.

For each of these see-saws, draw the
fulcrum in the place that will help the
see-saw balance.

Remember: to balance, heavy things
need to be close to the fulcrum.

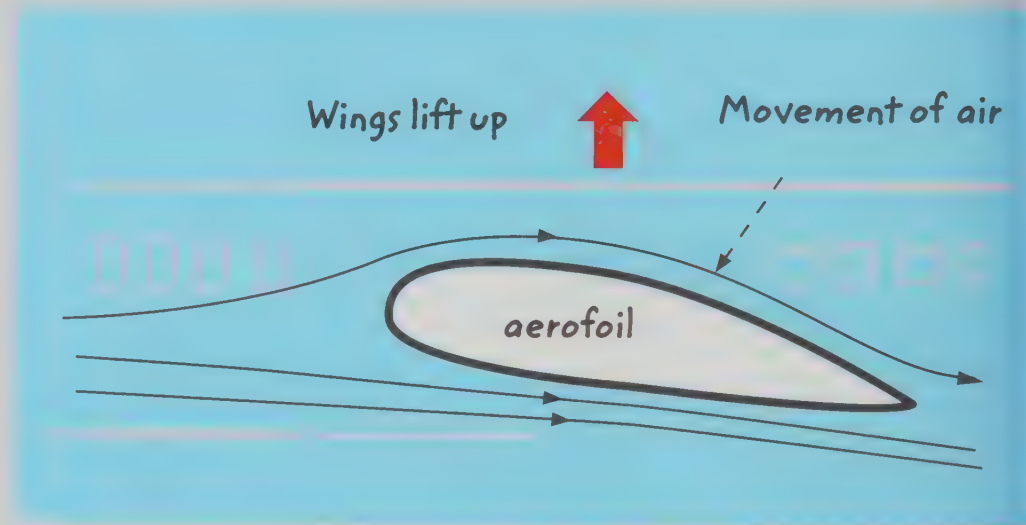


FLYING PLANES

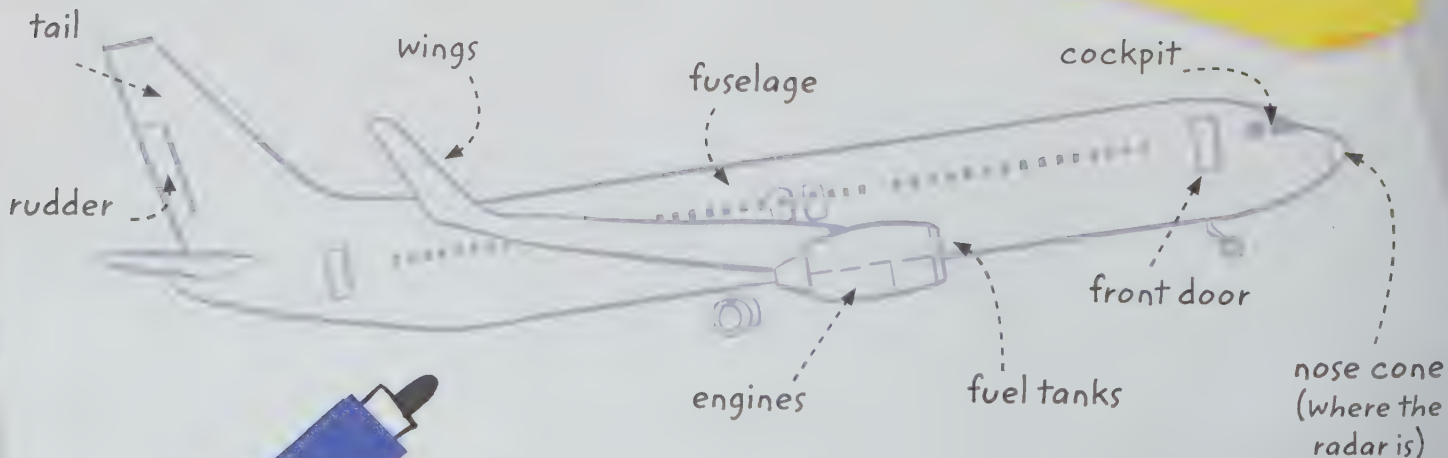
The problem of how to get a large metal aeroplane, filled with people and luggage, up into the sky and flying seems impossible to solve. One thing that helped engineers to solve this problem is the shape of the wings.



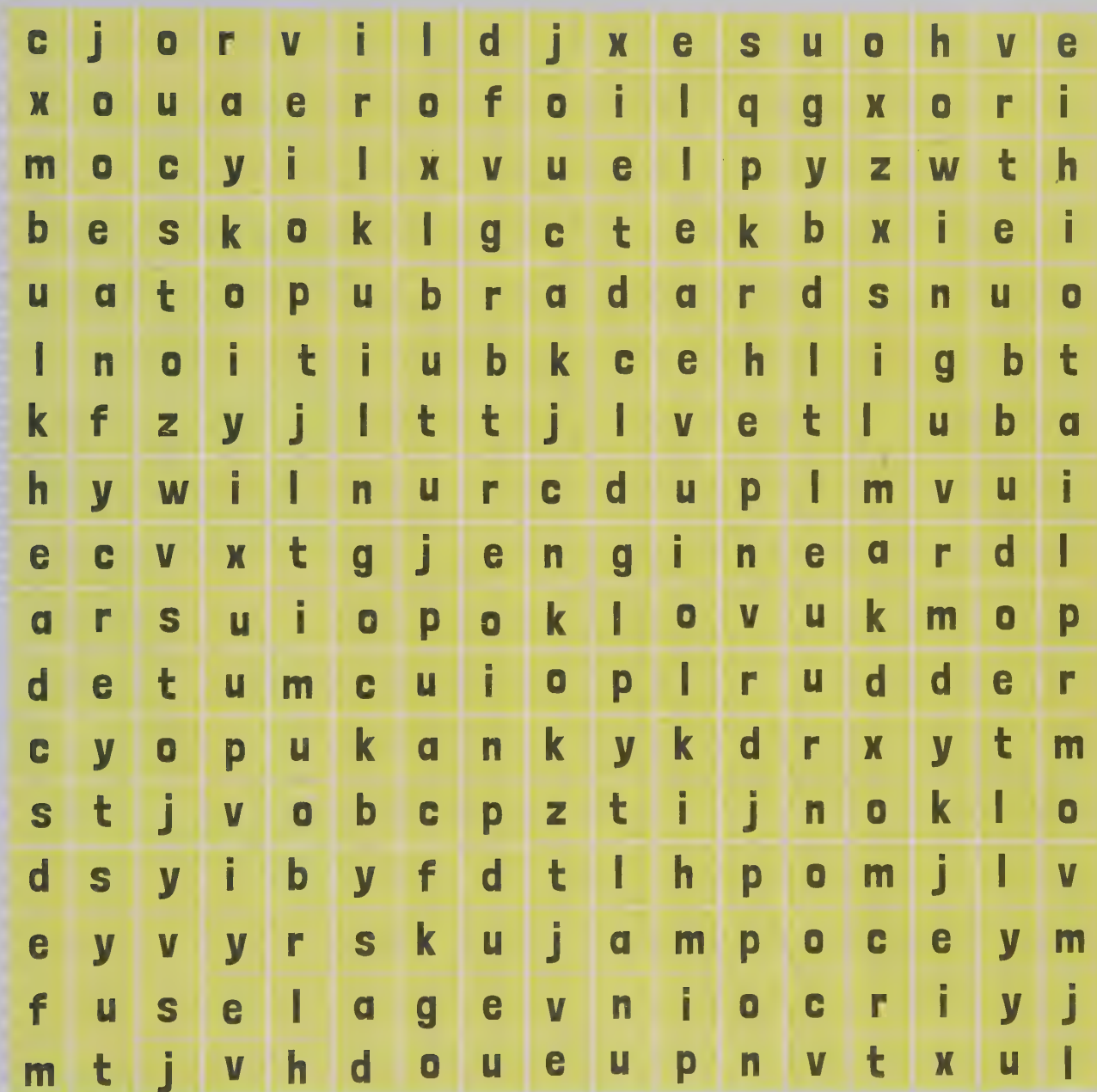
Aeroplane wings are shaped like an aerofoil. When the plane travels forward quickly (when it speeds up along a runway), the air finds it quicker and easier to move the shorter distance underneath the wing than to travel up over the bump of the wing. With more air underneath the wing, the wing lifts up, taking the aeroplane with it.



An engineer who designs planes is called an **aeronautical engineer**.



Can you find these aeronautical engineering words in this wordsearch?

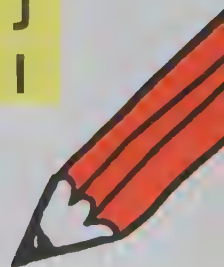


aerofoil
bulkhead
captain
cockpit

engine
fuselage
radar
rudder

tail
wing

Answers on
page 96.



PARACHUTES

Parachutes solve the problem of slowing down a falling person so they can land safely. They do this by increasing the person's air resistance.

When a person jumps out of an aeroplane gravity pulls them down to earth and air resistance slows them down. A person without a parachute has very little air resistance, and falls very fast. Because parachutes make such a large canopy, they collect a lot of air, and that increases air resistance, which slows the fall - so the person can land safely.



GRAVITY



AIR RESISTANCE

Colour in these parachutes!
Which one will slow down the
parachutist the most?



ROLLERCOASTERS

Although rollercoasters throw you up and down hills at thrilling speeds, engineers have worked out how to make the ride go by itself, without the power of an engine. Actually, engines turn on just once in a rollercoaster ride - to pull the rollercoaster up the first hill. After that, natural forces power the ride.

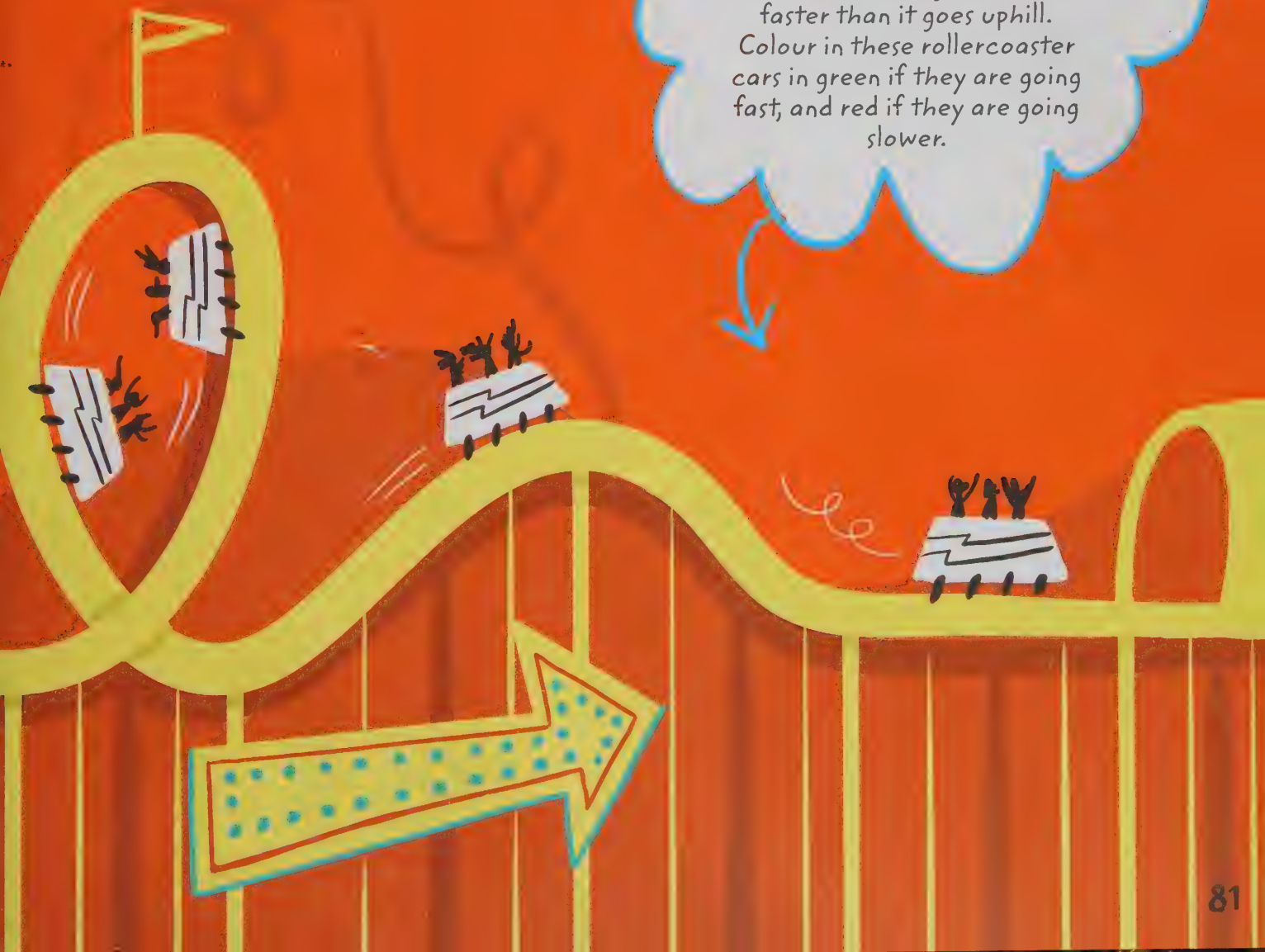


Once the rollercoaster is past the top of the first hill, gravity takes over and pulls the ride down.

When the rollercoaster starts going down that first drop, it goes so fast it gathers enough energy to send it all the way up the next hill - and so on, as it whizzes around the whole ride. At the end of the ride, the rollercoaster needs to put on the brakes to get rid of the energy and stop the ride.

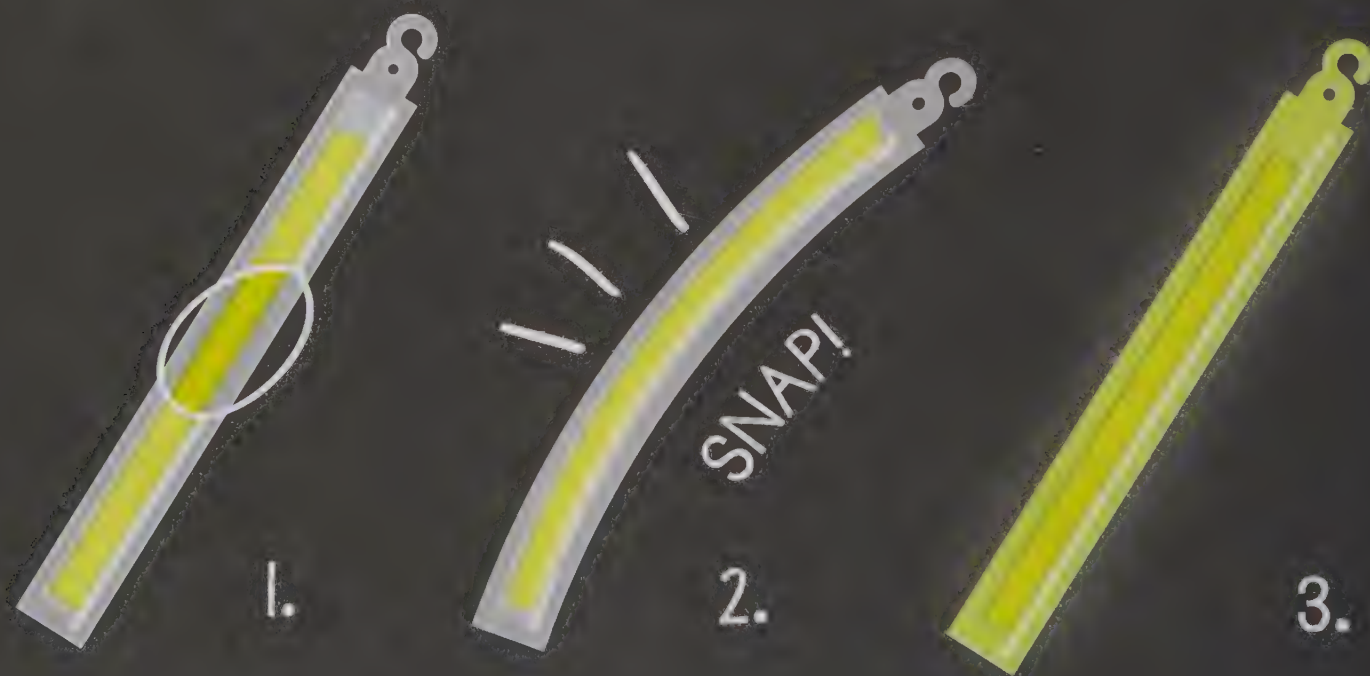


The rollercoaster goes downhill faster than it goes uphill.
Colour in these rollercoaster cars in green if they are going fast, and red if they are going slower.



GLOW STICKS

Glow sticks are great fun for parties but they only glow for a few hours. There are three ingredients inside a glow stick and as soon as they mix together it starts to glow. How do engineers solve the problem of the glow sticks glowing before someone is ready to use them? They keep one of the ingredients separate from the others in a small glass tube. When you want to make the stick glow, you snap the tube and shake – this mixes all three ingredients together.



When chemicals mix together and give off light it is called **chemiluminescence**.

An engineer who solves problems with chemistry is called a **chemical engineer**.

Search in this
scene for:

- 6 pink glow sticks
- 9 yellow glow sticks
- 7 green glow sticks
- 5 blue glow sticks

(Answers on page 97.)

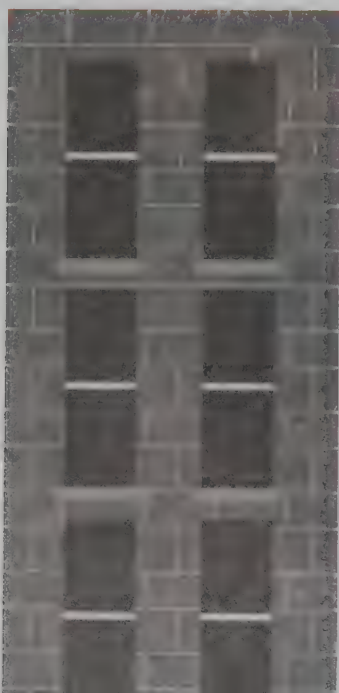


EARTHQUAKE PROOF

Some parts of the world have lots of earthquakes. Engineers have thought of ways to stop buildings from falling down even when the ground gives them a good shake. The most dangerous thing about an earthquake is falling buildings. People can survive being on quaking ground but they are in danger if a building falls on them. One way to 'earthquake-proof' a building is to let it be able to wobble with the quake. The more it can wobble, the less likely it is to fall down and injure people.



Look at these three buildings made from different material. Which one will survive being shaken best?



Brick



Sticks



Jelly

Spot 10 differences between these before and after pictures of an earthquake.



ECO PACKAGING

A problem facing us all is what to do with packaging when we don't need it anymore. Engineers have come up with some clever ways to reduce the amount of packaging we throw away and the amount of rubbish that builds up on the planet. One way of doing this is by making packaging from reused materials. But the best type of packaging breaks down by itself when you throw it away - this is biodegradable material. Some packaging even has seeds built into it, so if the packaging is buried the seeds can grow in the ground.



Imagine some packaging for these items. Make sure there is no unnecessary waste and that the materials are recyclable. Draw the packaging on the page.

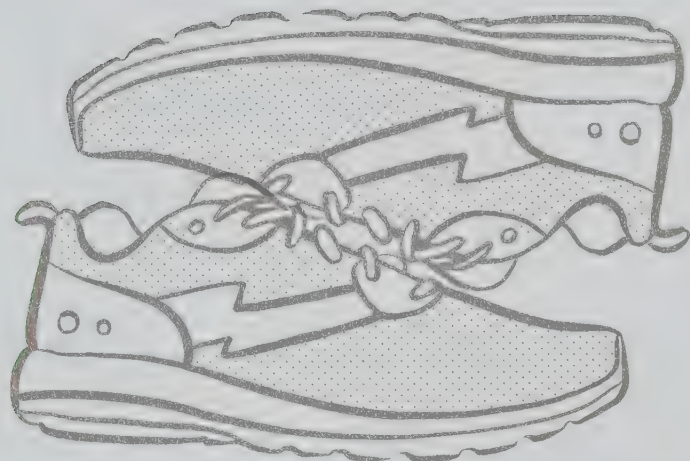
six eggs



pot plant



a pair of
trainers



a lightbulb



a football



a fish

RUNNING BLADES

Engineers have helped people without lower legs solve the problem of how to walk and run. Running blades don't look like normal legs, ankles and feet but they can make people run just as well as - and maybe even faster than - non-disabled runners. They are made from a very strong but light material called carbon fibre and the way they are shaped makes them bendy like a spring. This springiness helps the runner to sprint forwards in the same way as a natural leg does. 

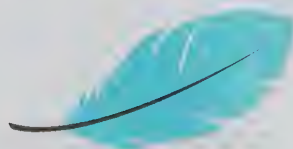
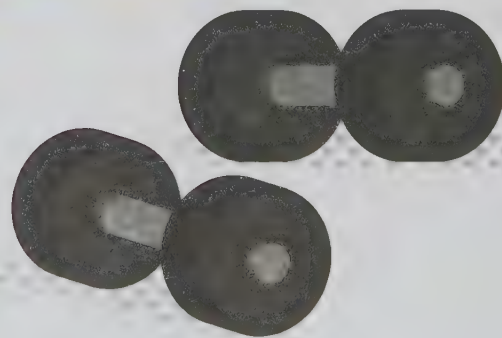


Can you find materials in this selection that might be useful for an engineer making a running blade?

Circle all the objects that are strong in **black**.

Circle all the objects that are flexible in **red**.

Circle all the objects that are light in **blue**.



DRONING ON

A drone is a sort of robot that can do its job without a human being there with it. There are drones that work on land and sea but flying drones are becoming more and more popular because they are so useful.

A flying robot with a camera attached to it can get to places and see things that humans cannot - and it can do it more quietly than a human in a helicopter!



Contains a GPS chip to find locations, an altimeter to tell its height, and an ultrasound scanner to tell how close it is to the ground

Controlled by radio waves or Wi-Fi

Four propellers for stability and to carry more



camera

Can you work out which of these jobs a flying drone can do and which are made up? The answers are at the back of the book.

Cook a three-course meal.

Tell farmers which of their crops are not growing properly.

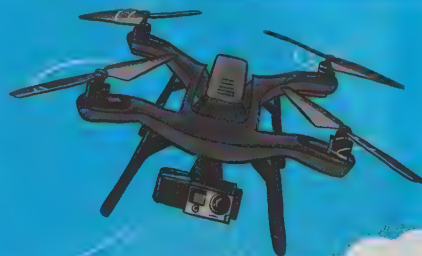
Do your homework.

Help to stop people poaching endangered species.

Help to build a high-rise building.

Put out forest fires.

Shop for clothes.



Brush your teeth for you.

Deliver pizza.

Help to save lives.

Take selfies.

Film long views from high in the sky for Hollywood films.

Play football.

Do laundry.

COMPUTER ENGINEERING

Computer engineers design and build computers to help make our lives easier in a huge number of ways. Computers are part of our everyday lives – not just the computers you write and play on, household devices like washing machines and digital radios have computers inside them as well.

Computers can't think for themselves – they can only do what they are told to do. That means the computer engineers have to do all the thinking first and make sure they give computers the right set of instructions, and in the right order. If there are mistakes in any of the steps, things can go very wrong.



This computer has been given instructions for getting dressed in the morning – but the instructions are in the wrong order! Draw the clothes onto the person opposite in the order the computer suggests. How do they look?





CODING

Coding is the way of giving instructions to a computer. It's a bit like talking to the computer in its own language. There are two main steps to coding. First, you need to think about the thing you want the computer to do. This could be something like getting dressed in the morning or finding the quickest route to a place. Then you need to break down that thing into a series of instructions. Most importantly, they need to be in the right order, as you saw on the page before.



Think about making a cheese sandwich with six ingredients:

2 slices of bread
mayonnaise
1 lettuce leaf
1 slice of tomato
1 slice of cheese

Tell the computer which order to use the ingredients in.



Can you find these sandwich ingredients in the right order in this set?



ANSWERS

Pages 70-71

Little Red Riding Hood

How to be an Engineer

Spells, Charms and Potions

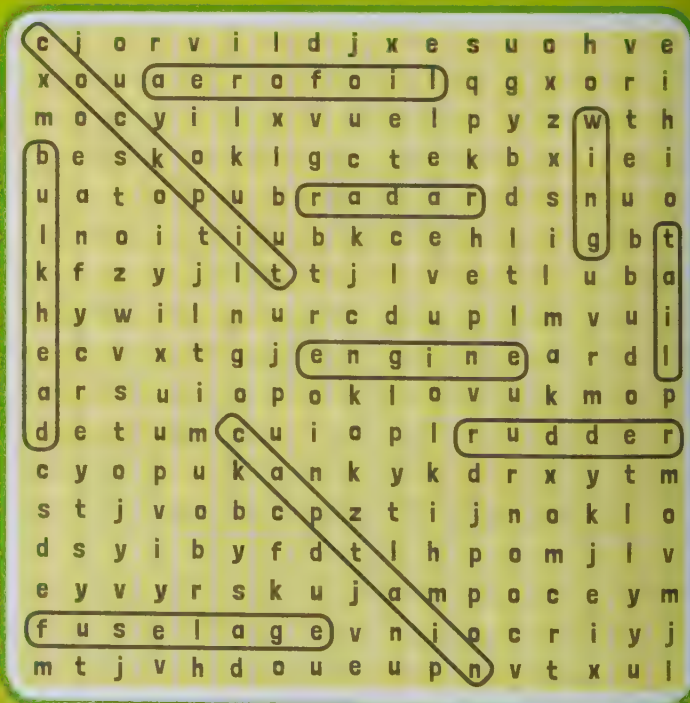
Goldilocks and the Three Bears

The Buildings of Ancient Egypt

page 73



page 75

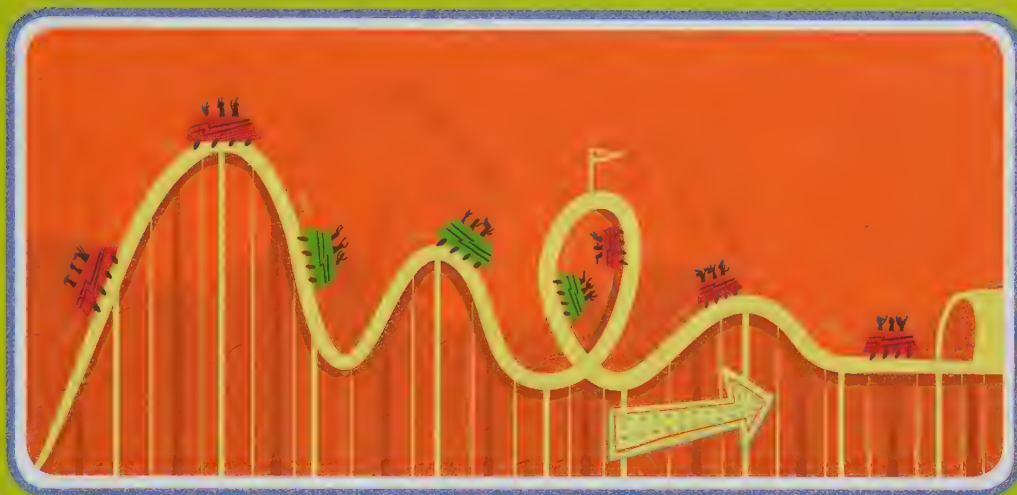


page 77

page 79

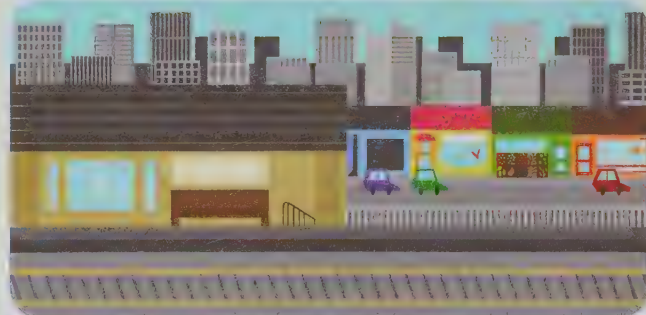


page 80-81



page 84-85

The jelly building
will survive being
shaken best.



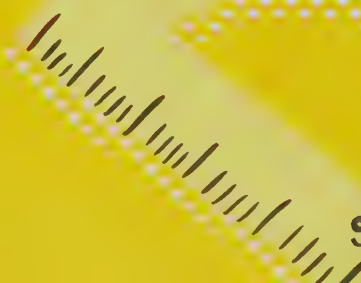
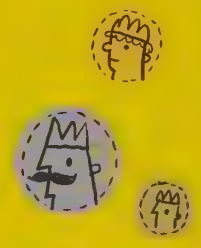


True answers with some more information:

- **Tell farmers which of their crops are not growing properly.**
Drones can fly over large areas of farmland to get a better look at how crops are growing, more easily and quickly than a farmer could.
- **Film long views from high in the sky for Hollywood films.**
Without drones, filming like this would take a lot more equipment and time.
- **Help to build a high-rise building.**
Drones can carry cable high up buildings and even weave them to help build a structure.
- **Put out wild fires.**
Drones can fly to spot wildfires and use special cameras to see through fire smoke, giving information to firefighters about the size of the blaze.
- **Help to stop people poaching endangered species.**
Drones can keep track of groups of endangered animals by flying closer than a human could but keeping enough of a distance to not disturb the animals.
- **Help to save lives.**
Sometimes drones can deliver life-saving medical equipment faster than an ambulance could get there.
- **Deliver pizza.**
Drones can sometimes deliver more quickly than someone on a moped, and deliver pizza while it is still hot.
- **Take selfies.**
With a camera a drone can move to the right place to take a perfect selfie!



MATHS ACTIVITY Book



MEASURING AND GUESSING

There are lots of ways to measure lengths. You can use a ruler or tape measure to measure accurately, or you can estimate - which is a bit like clever guessing.

Estimating takes practice but there are some tricks to help you.



Take a look at these shapes and use the guide to estimate their sizes. The pencils and tomatoes are the correct size on the page so you can use a ruler to check your estimate.

Guide

1 cm $\approx$ the width of a pencil

3 cm $\approx$ the length of a cherry tomato

30 cm $\approx$ the height of a sheet of A4 paper

1 m $\approx$ the width of a single bed

2 m $\approx$ the height of a door in a house

Symbols

=

This sign means 'equal to' and is used when measuring accurately.

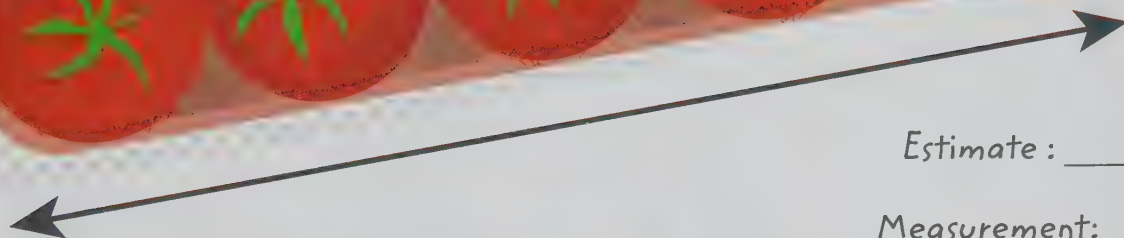
$\approx$

This sign means 'approximately equal to' and is used when estimating measurements.



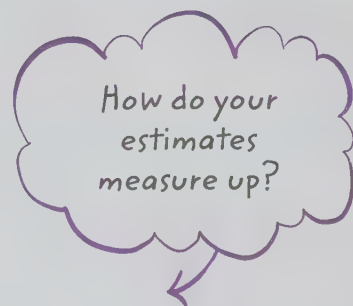
Estimate : _____

Measurement: _____



Estimate : _____

Measurement: _____



Estimate : _____

SHOPPING

Going shopping involves maths! You need to add together your money to check you have enough to buy everything and to give the cashier the right amount.



Check the prices of everything on your shopping list against the money you have in your pocket. On your shopping list, write down how much each will cost and which coins you'll need. Put a cross over each coin when you've used it.
Answers on page 126!

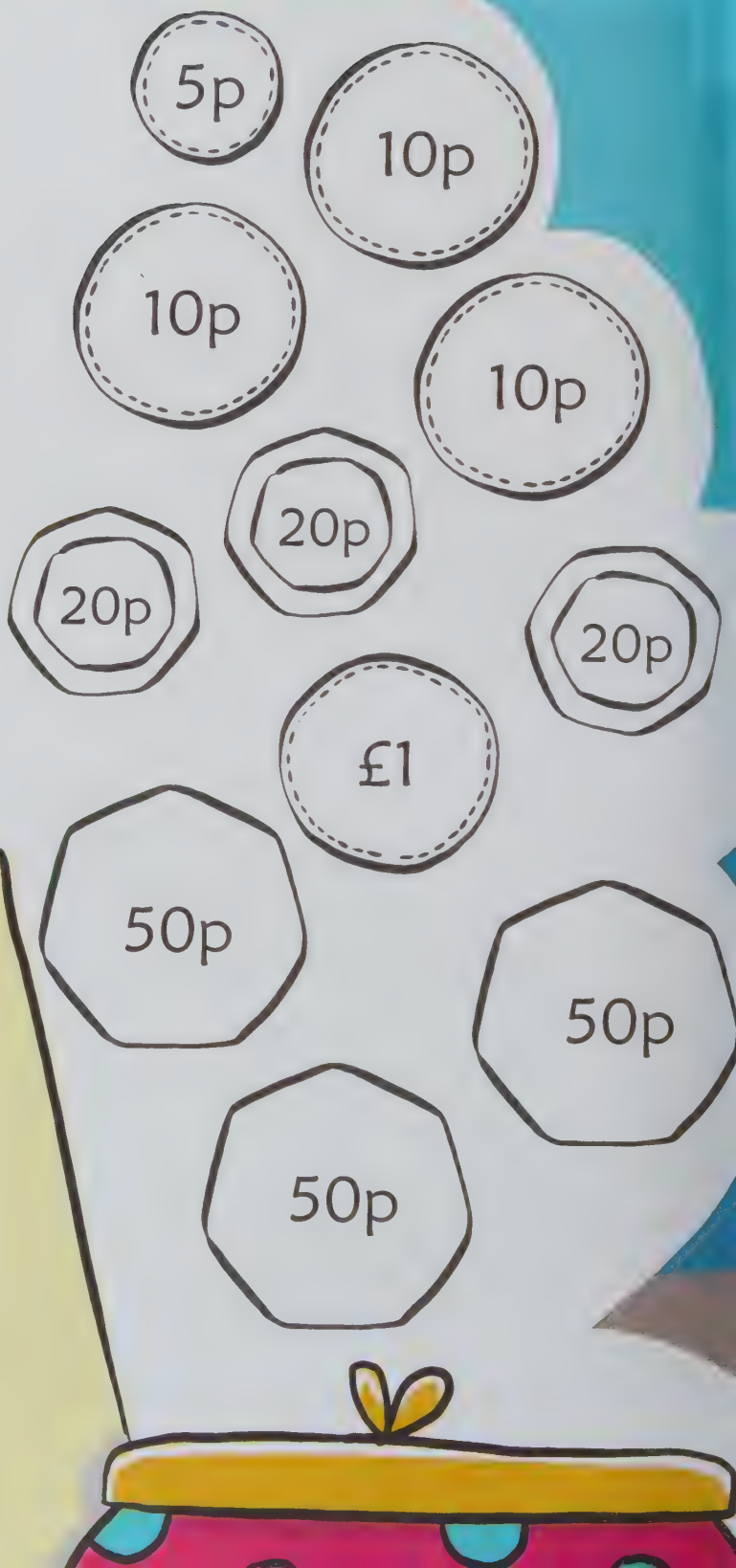
2 lemons

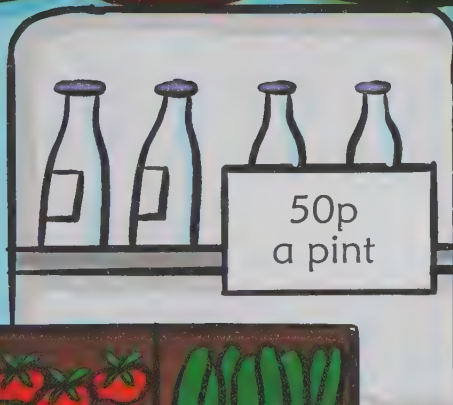
4 bananas

1 pint of milk

1 loaf of bread

3 apples





50p
a pint



80p



OPEN



20p each



25p each

25p each

AT THE POST OFFICE

Bigger things aren't necessarily heavier than smaller things. A pillow filled with feathers is larger than a brick, but the brick is heavier. We can measure weight by using scales, and the metric scale measures in grams (g) and kilograms (kg). There are 1,000 grams in a kilogram.



Check the scales for each of these parcels and write their weights in the spaces provided.

Answers on page 126!

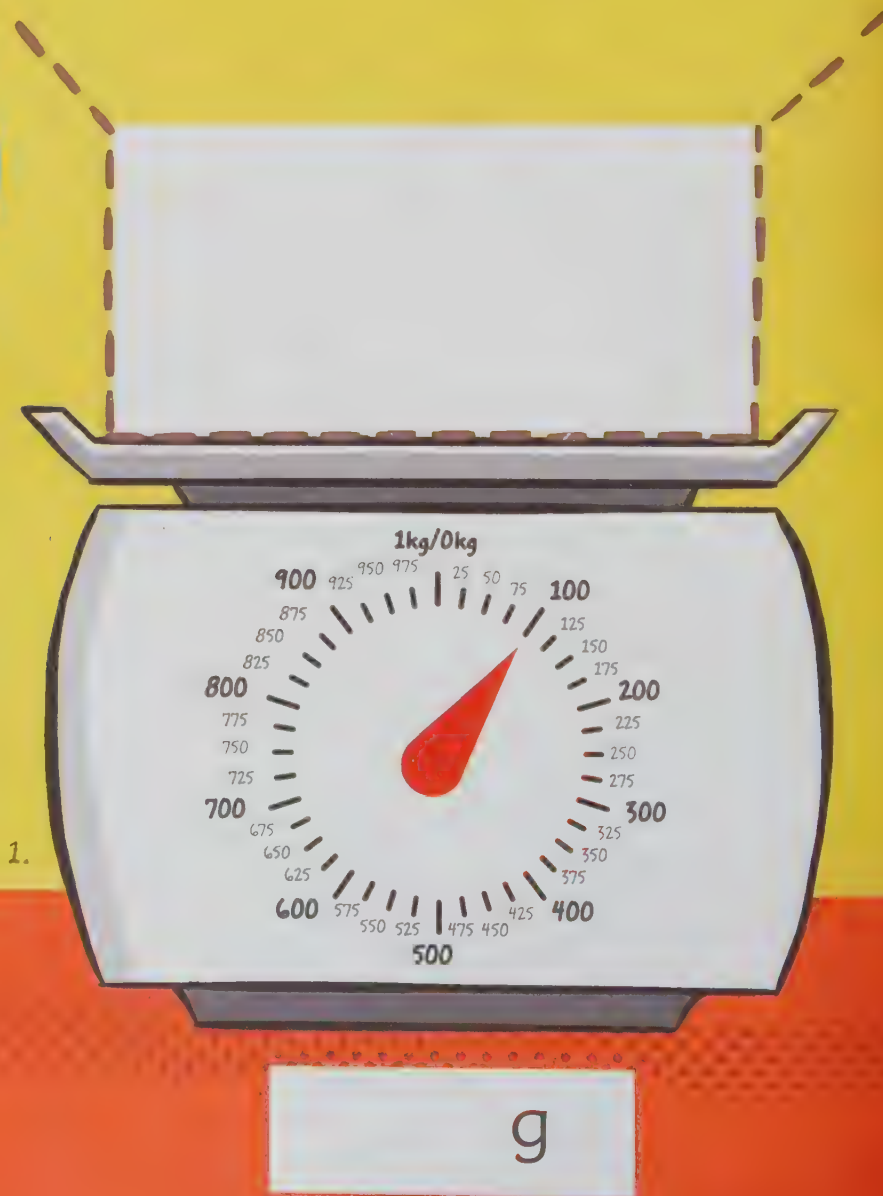
What do you think is in each box?

Draw your answers!

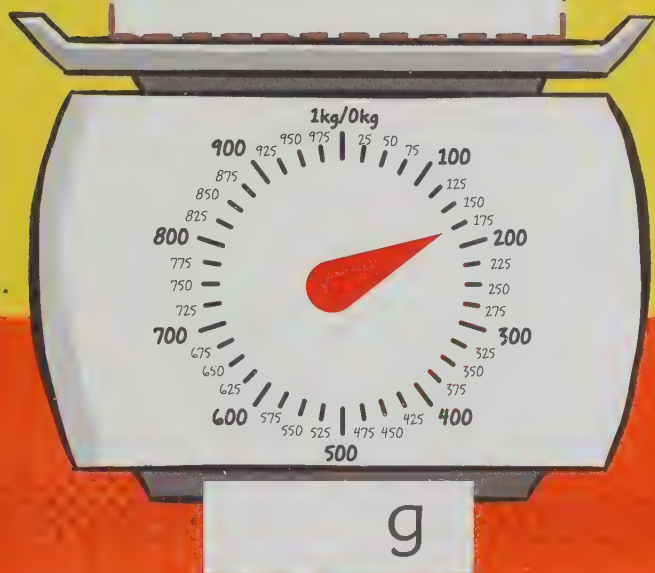
Here are some sample weights to give you ideas. But you can also weigh items around you and choose things to put in the parcels that are not on this list.

Remember this little symbol? $\approx$

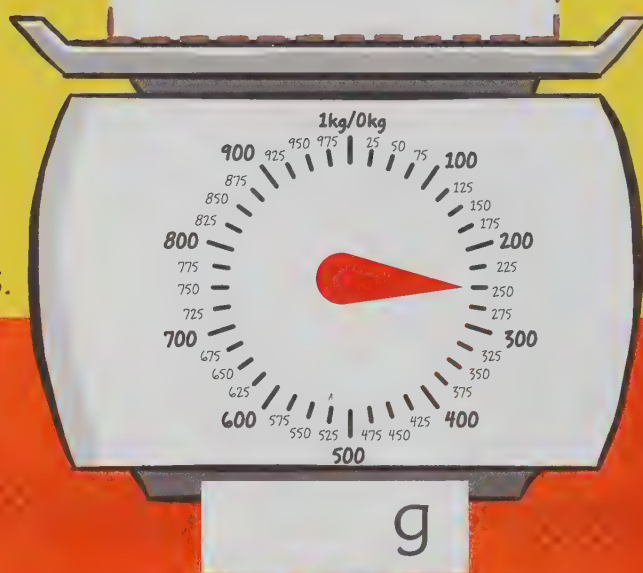
- a packet of crisps $\approx$ 35g
- a tennis ball $\approx$ 50g
- a DVD in its case $\approx$ 100g
- a mobile phone $\approx$ 150g
- a cricket ball $\approx$ 175g
- an exercise book $\approx$ 200g
- a football $\approx$ 440g
- a small bag of sugar $\approx$ 500g



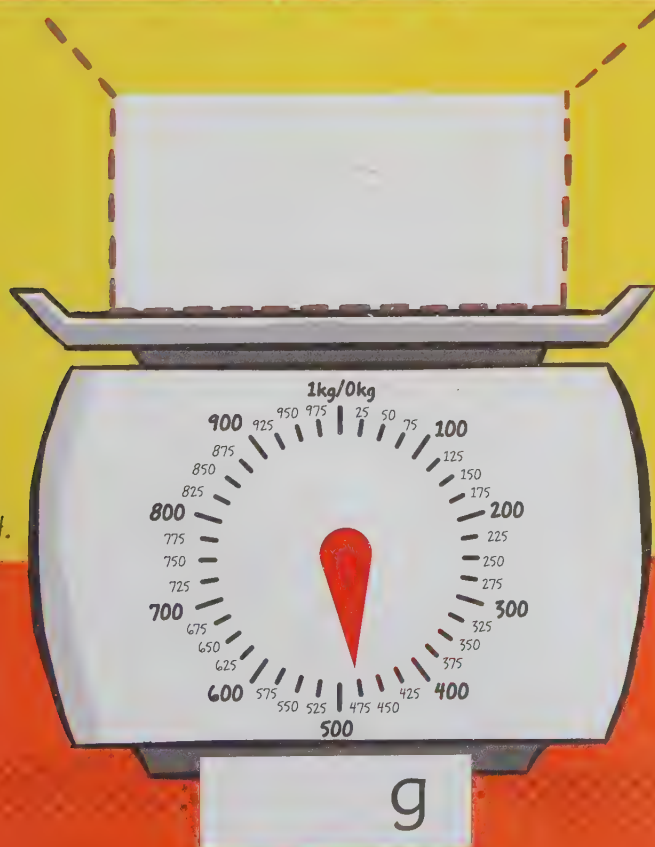
2.



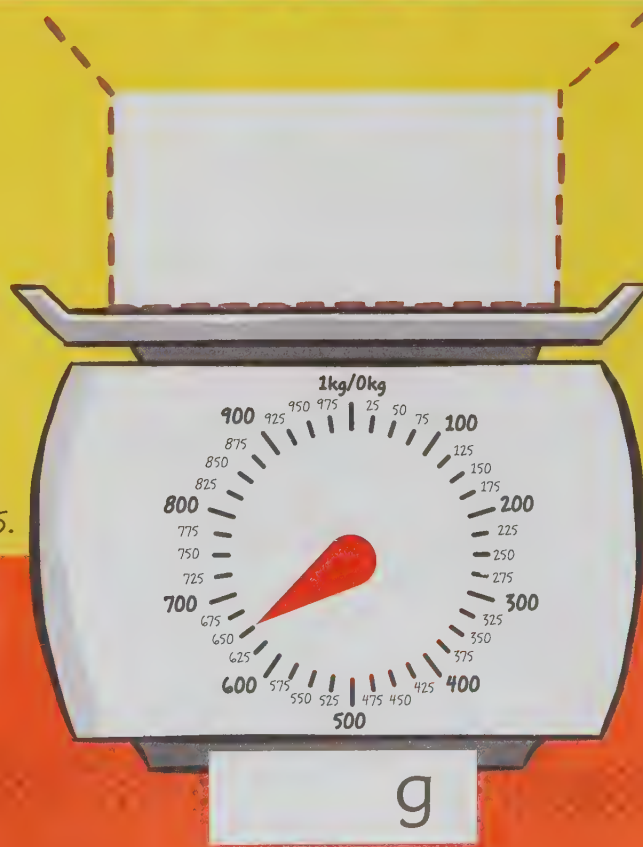
3.



4.



5.



TAKE AWAYS

Things are taken away – or subtracted – in all sorts of everyday situations. Some things are simple to count, if they are all the same size and shape, such as squares of a chocolate bar. Other things, like liquids, have to be measured in fractions (or equal parts) of a whole unit. The whole unit could be an official way of measuring, such as litres, or anything useful, like a bottle or cup.

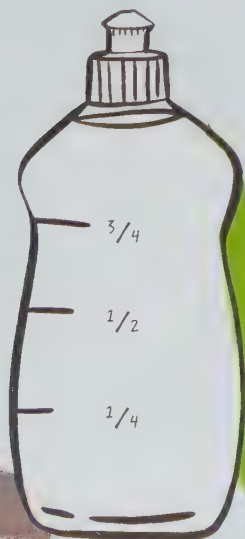


For each of these objects, shade in the amount that has been taken away or used up, and write down the amount left.



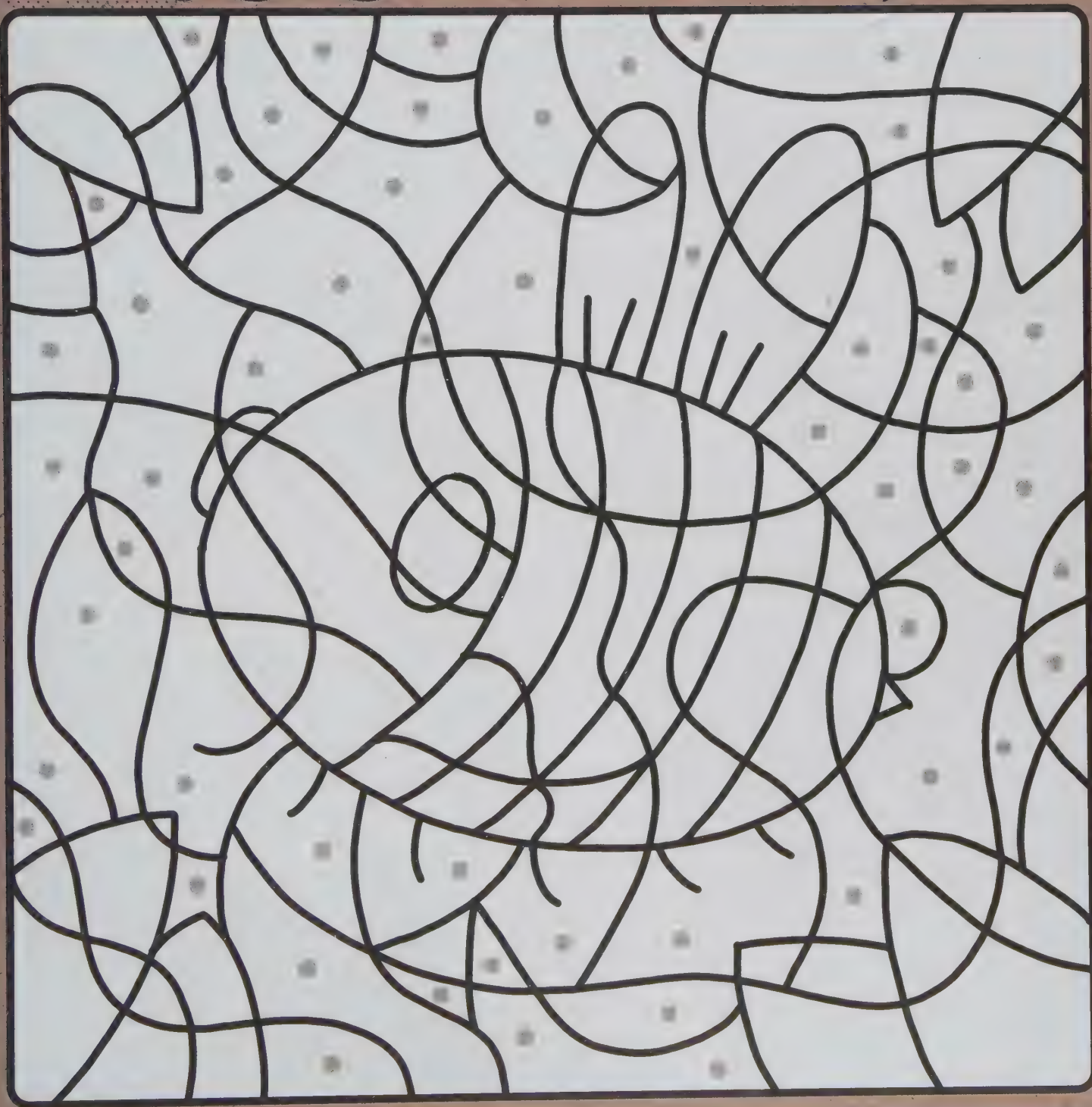
Someone has eaten 7 squares.
Amount left: _____

A quarter of the bottle has been used.
Amount left: _____



6 pins have been knocked over
Amount left: _____

Subtract all the spaces with a dot marked in them by colouring them in – and you'll find a picture revealed in the space left behind.



VOLUME

Capacity - also called 'volume' - is a measure of how much space something takes up. You can measure the capacity of things that can be poured from one container to another. Capacity can be measured in millilitres (ml) and litres (l), and there are 1,000 millilitres in a litre. However, you might see capacity measured in all sorts of ways.



Here are some common ways capacity is measured:



a pinch



a drop



a teaspoon



a tablespoon



a cup

In this recipe, some of the ingredients are measured in weight, and some are measured in volume. Circle the words that are telling you what volume to use.

Clue: Remember - volume isn't always measured in just millilitres and litres.

Vanilla Cupcakes

110g butter

110g caster sugar

2 free-range eggs

1 teaspoon vanilla extract

110g self-raising flour

1-2 tablespoons milk

Buttercream icing

140g butter

280g icing sugar

1-2 tablespoons milk

a few drops food colouring

Decorate these
cupcakes!



1. Preheat the oven to 180° C (350° F) or Gas Mark 4 and line a muffin tin with paper cases (ask an adult to help you).

2. Cream the butter and sugar together then slowly beat in the eggs and vanilla extract.

3. Carefully mix in the flour adding little drops of milk as you go.

4. Bake for 10-15 minutes until golden on top then leave to cool.

5. Beat the butter for the icing until soft then add half of the icing sugar and beat some more.

6. Add the rest of the icing sugar and the milk to the butter and mix until smooth.

7. Decorate your cupcakes! Use food colouring in the icing for a special finish.

MULTIPLES

Multiplication is adding the same number to itself an amount of times. So, 3×3 means to add 3 to itself three times, or $3 + 3 + 3$.



You can represent 3×3 in a grid, too, where there are 3 rows and 3 columns, like this:



or 2×4
like this:



And counting the number of squares gives you the answer to the question.



Use the pictures opposite to help you solve these multiplication questions.

Look for the boxes that match the number of rows and columns in the question.

$2 \times 5 =$

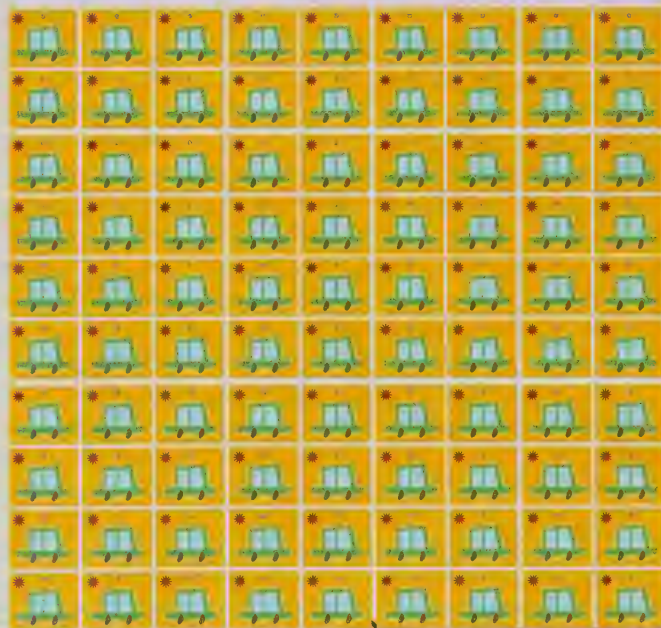
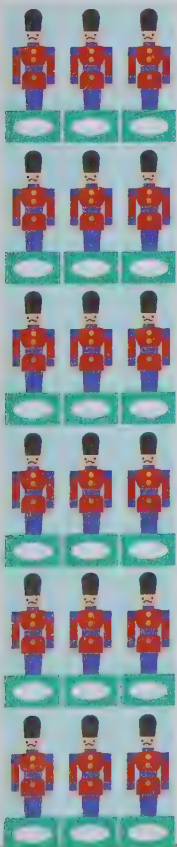
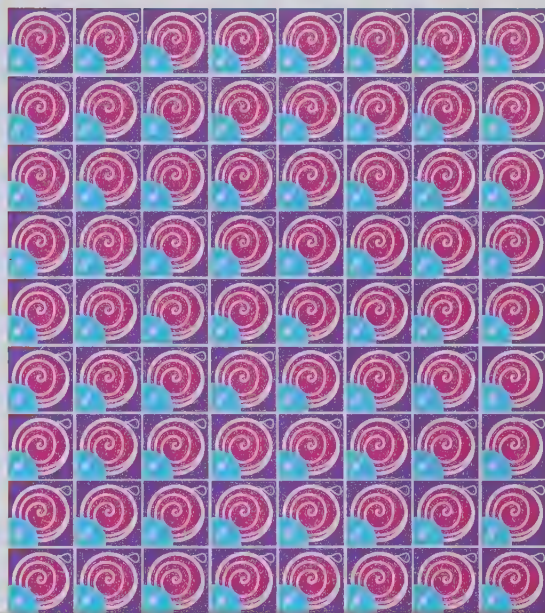
$5 \times 6 =$

$3 \times 6 =$

$8 \times 9 =$

$4 \times 5 =$

$9 \times 10 =$



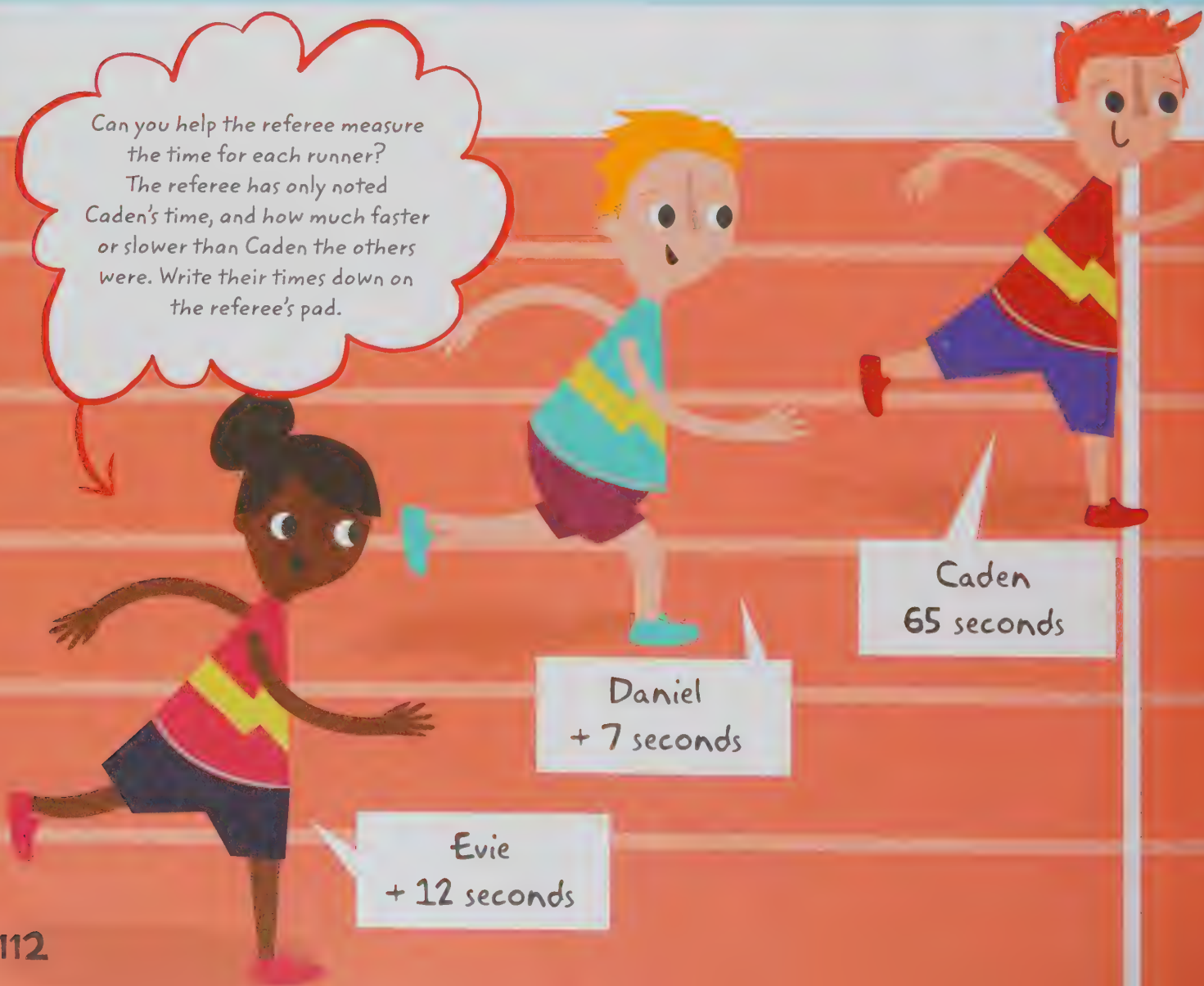
RACING MATHS

It's important to know how to measure time. Telling the time helps you arrive at school on time and helps your teacher make sure your lessons last the right amount of time. People running races also need to measure time to know exactly how long they have taken. Time can be measured in seconds, minutes and hours. There are 60 seconds in a minute and 60 minutes in an hour.



Can you help the referee measure the time for each runner?

The referee has only noted Caden's time, and how much faster or slower than Caden the others were. Write their times down on the referee's pad.



Ahmed
- 10 seconds



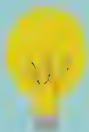
Betty
- 5 seconds



1st : Ahmed _____
2nd : Betty _____
3rd : Caden 1 minute 5 seconds
4th : Daniel _____
5th : Evie _____

SHARING

Sharing things out is called 'division'. Things can be shared out evenly but sometimes there will be leftovers known as the remainder.



These cakes have all been cut into different numbers of slices. First, count the number of slices, then use different coloured pencils to share out the slices equally amongst the number of guests listed for each cake. Each guest can have more than one slice of cake but they must all have the same number of slices each. Here's one to start you off.

Number of slices: 8
Share between 4 guests
Slices left over: 0

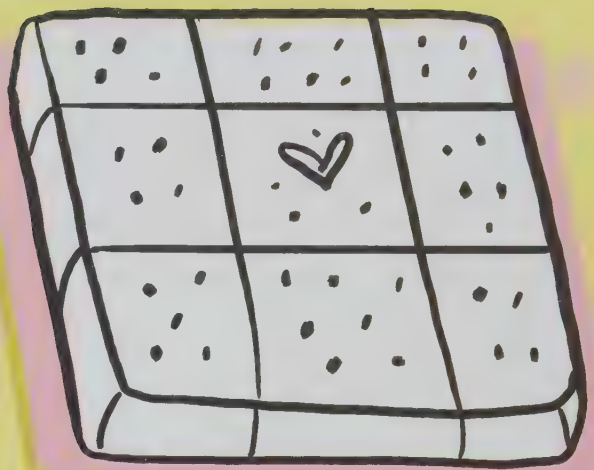




Number of slices: _____

Share the slices between 6 guests

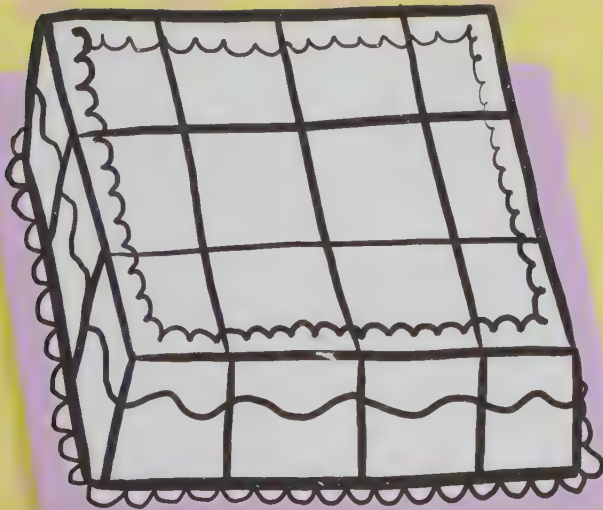
Slices left over: _____



Number of slices: _____

Share the slices between 4 guests

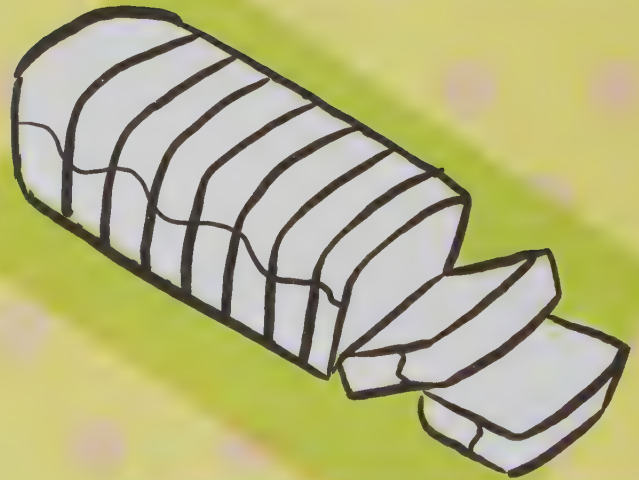
Slices left over: _____



Number of slices: _____

Share the slices between 5 guests

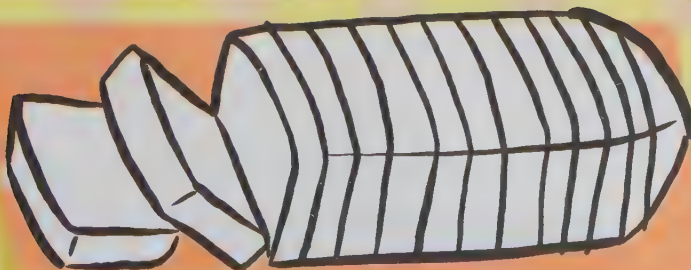
Slices left over: _____



Number of slices: _____

Share the slices between 9 guests

Slices left over: _____



Number of slices: _____

Share the slices between 7 guests

Slices left over: _____

CODE BREAKER

Codes are used to hide information. The important part is the key, which helps you decipher the code. There are many different ways to write code. Some are quite famous, but the hardest to crack are the ones that are made up specially with secret rules that only a very small number of people know.



Here are some famous codes. For each one, use the key to decode the secret messages.

THE REVERSE ALPHABET

The clue's in the title! The code is simply the reverse of the alphabet. This code is easy to crack but that also means you'll never forget how to crack it, even if you lose your key.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

D	S	Z	G		R	H		U	L	I		W	R	M	M	V	I	?

AUGUSTUS'S CODE

Another simple code, this time the alphabet is all shifted on one place, so that A=B, B=C, and so on until Z=A.

This message uses the bottom line of the code.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Z	T	F	T	R	S	T	R		V	Z	R		Z		Q	N	L	Z	M

PICTOGRAM CODE

You don't always need to use letters in your code!
Pictograms, or little pictures, can take the place of letters.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
✌️	✋	👍	👎	👉	👈	👆	👇	👐	😊	😐	😞	💣	☠️	🚩	🚩	✈️	⚙️	💧	❄️	✚	✚	✚	✚	✚	✚
👐	💧		❄️	👉	👐	💧		👉	✌️	💧	✚		🚩	⚙️		👉	✌️	⚙️	👎	?					

Have a go at making your own code.

Fill in the empty boxes to give each letter a code, and then use your code to write a secret message! Don't forget to share the code with a partner so they can decipher your message.

A	B	C	D	E	F	G
H	I	J	K	L	M	N
O	P	Q	R	S	T	U
	V	W	X	Y	Z	

TURN THE TABLES

Making notes of the things we see can help us to see patterns. Writing stuff down helps us to take more notice.

Look at this scene and record information about it in the table by putting ticks in the right boxes. The first line has been filled in for you.



	mum	dad	brother	sister	baby
eating cereal			✓	✓	✓
eating toast					
curly hair					
straight hair					
wearing red					
smiling					
drinking juice					
drinking milk					





BAR CHARTS

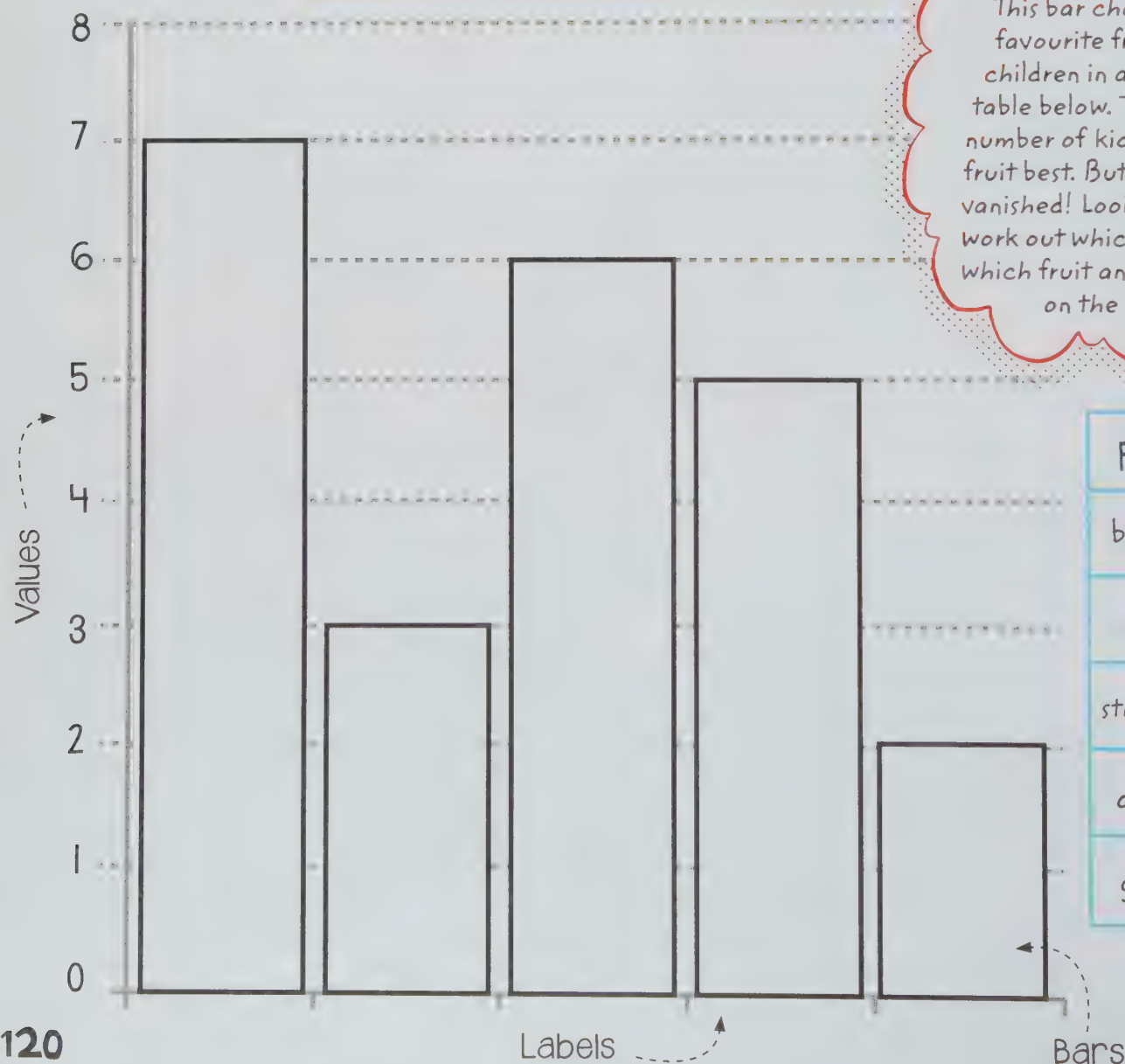
Tables gather numbers in a grid. Bar charts are a fun way to turn this information into something visual. A 'bar' on the chart represents the number value in the table.



Favourite Fruit

Title

This bar chart shows the favourite fruit of all the children in a class. See the table below. The value is the number of kids who like each fruit best. But the labels have vanished! Look at the table to work out which bar represents which fruit and draw the fruit on the right bar.

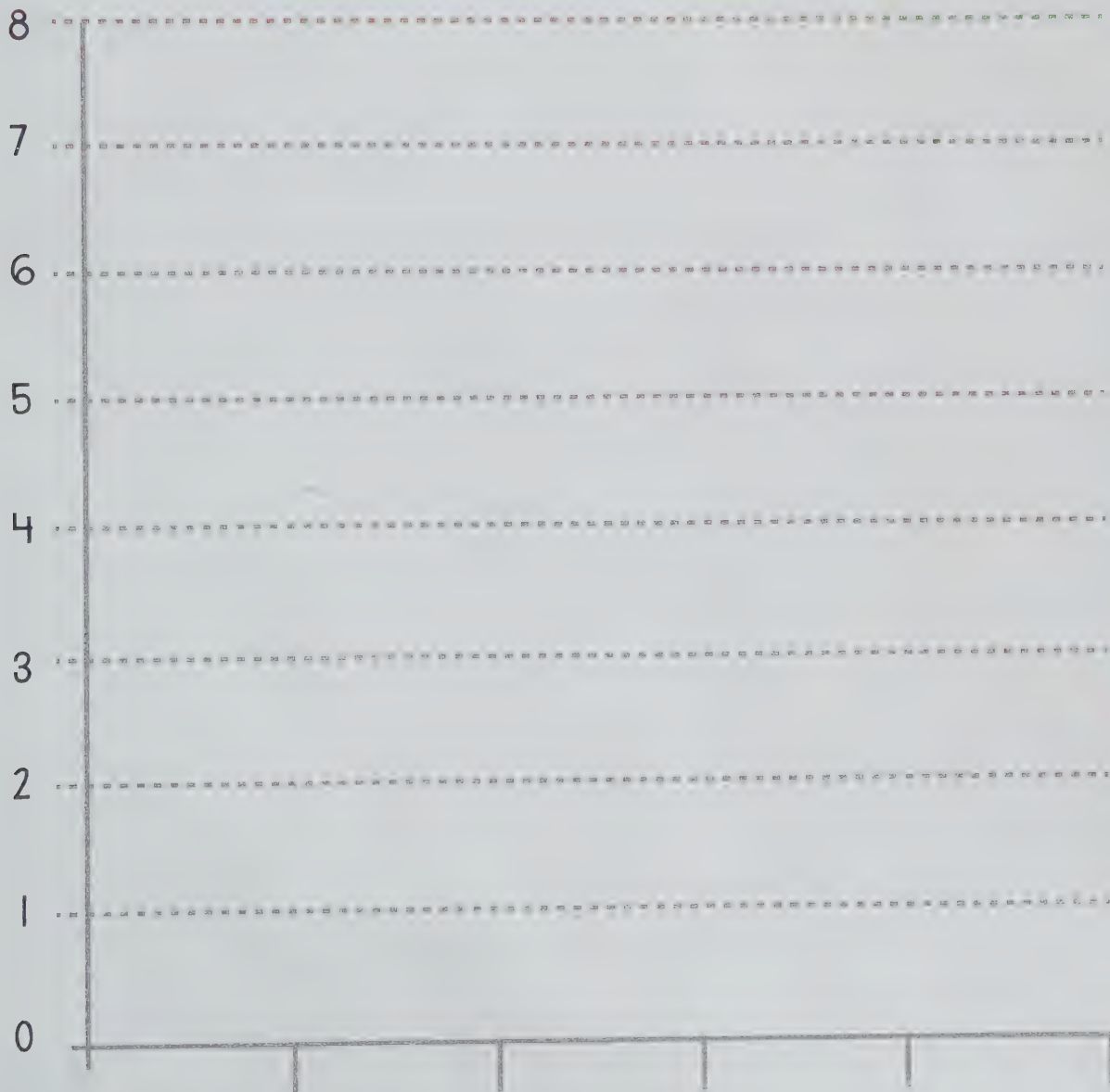


Fruit	Value
banana	6
apple	7
strawberry	5
orange	2
grapes	3



Victor gathered this information about his friends' favourite hobbies. Use a pencil and ruler to turn the information in this table into a bar chart.

Hobby	Value
football	8
ballet	4
swimming	5
karate	2
scouts	5



RIGHT ANGLES

When two straight lines meet they make an angle.

A 'right angle' is a special kind of angle, shaped like an 'L' - once you can recognise a right angle you'll see they are all around us.



See if you can find eight right angles in this picture. Circle all the ones you can find.





ROUNDING UP

Sometimes it's easier to understand larger numbers if they are rounded up or down to something simpler.



Numbers 1 to 4 are rounded down to the nearest 0. So 13 becomes 10.

Numbers 5 to 9 are rounded up to the nearest 0. So 27 becomes 30.

You can also round off numbers and use other words to describe numbers. Here are some words you can use to describe a number without saying the exact number.



roughly

more than

almost

less than

nearly

close to

about

In these conversations, reply to the friend talking in exact numbers with another way of describing the number, rounded off. Use the words suggested on the opposite page to help you.

I have 97 action figures!

You have nearly 100 action figures!

I can skip 32 times without stopping!

I am 8 years and 11 months old.

I scored a basket 11 times in a row!

There are 26 pupils in my class.

ANSWERS

Pages 100-101

Pencils

Estimate : 6cm

Measurement : 6.3 cm

Punnet of cherry tomatoes

Estimate : 15cm

Measurement : 15.3 cm

House

Estimate : 6 m

Pages 102-103

2 lemons = 40p ($2 \times 20\text{p}$)

4 bananas = £1 ($1 \times £1$)

1 pint of milk = 50p ($1 \times 50\text{p}$)

1 loaf of bread = 80p ($1 \times 50\text{p}, 1 \times 20\text{p}, 1 \times 10\text{p}$)

3 apples = 75p ($1 \times 50\text{p}, 2 \times 10\text{p}, 1 \times 5\text{p}$)



Page 104-105

Here are the weights showing on the scales and some ideas for what could be inside the parcels. You might have chosen other things to go in the parcels by weighing items around you.

1. The scale shows 100g equals a DVD in its case
2. The scale shows 175g equals a cricket ball
3. The scale shows 250g equals an exercise book plus a tennis ball
4. The scale shows 475g equals a football a a packet of crisps
5. The scale shows 650g equals a small bag of sugar a a mobile phone

Page 106

Chocolate bar

Amount left: 23

Bottle of laundry liquid

Amount left: $\frac{3}{4}$

Bowling pins

Amount left: 4



Page 107

Page 108-109



Page 110-111

$$\begin{aligned} 2 \times 5 &= 10 \\ 3 \times 6 &= 18 \\ 4 \times 5 &= 20 \\ 5 \times 6 &= 30 \\ 8 \times 9 &= 72 \\ 9 \times 10 &= 90 \end{aligned}$$



Page 112-113

1st : Ahmed 55 seconds
2nd : Betty 1 minute
3rd : Caden 1 minute 5 seconds
4th : Daniel 1 minute 12 seconds
5th : Evie 1 minute 17 seconds

Vanilla cupcakes

110g butter
110g caster sugar
2 free-range eggs
1 teaspoon vanilla extract
110g self-raising flour
1-2 tablespoons milk

Buttercream icing

140g butter
280g icing sugar
1-2 tablespoons milk
a few drops food colouring

Page 114-115

Cake 1

Number of slices: 12

Slices left over: 0

Cake 2

Number of slices: 9

Slices left over: 1

Cake 3

Number of slices: 12

Slices left over: 2

Cake 4

Number of slices: 10

Slices left over: 1

Cake 5

Number of slices: 14

Slices left over: 0

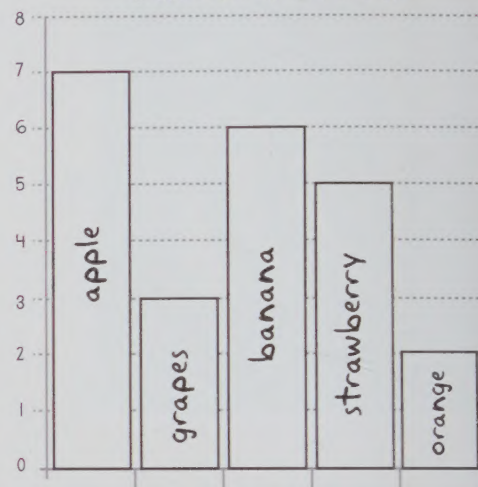
Reverse Alphabet: What is for dinner?
 Augustus's Code: Augustus was a Roman
 Pictogram Code: Is this easy or hard?

	Mum	Dad	brother	sister	baby
eating cereal			✓	✓	✓
eating toast	✓	✓			
curly hair	✓		✓		
straight hair		✓		✓	
wearing red			✓		✓
smiling	✓		✓		✓
drinking juice			✓	✓	
drinking milk					✓

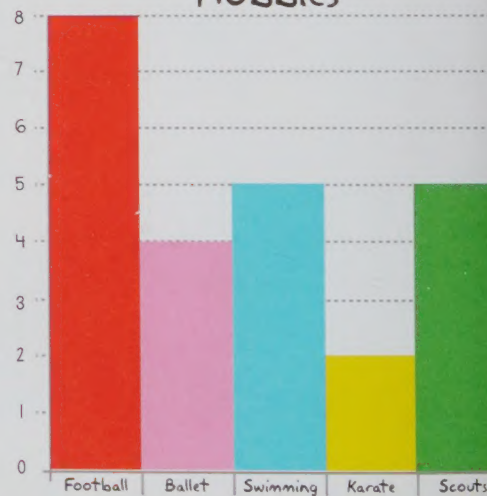
There are 8 right angles in the picture.



Favourite Fruit



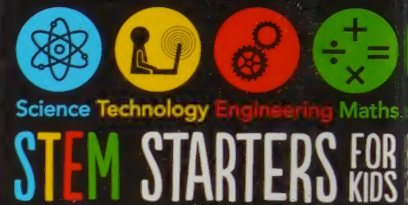
Hobbies



Possible answers:

- You can skip more than 30 times!
- You are nearly 9 years old.
- You have scored more than 10 baskets in a row.
- You have close to 30 pupils in your

written by Jenny Jacoby,
Sam Hutchinson and Catherine Bruzzone
designed and illustrated by Vicky Barker



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